IRON & COAL

THE IRON AND COAL TRADES' REVIEW

VOL. 182
No. 4,839

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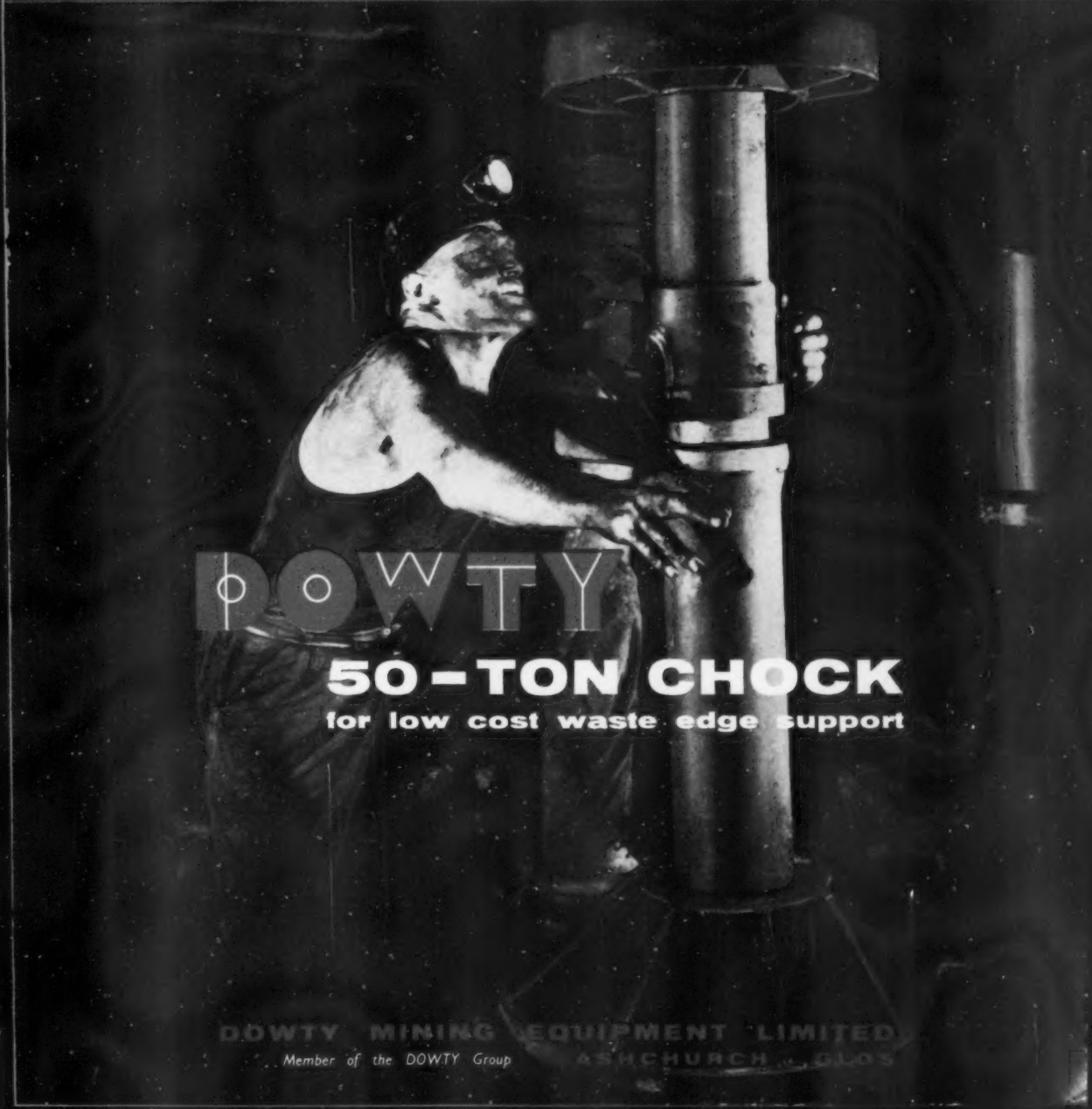

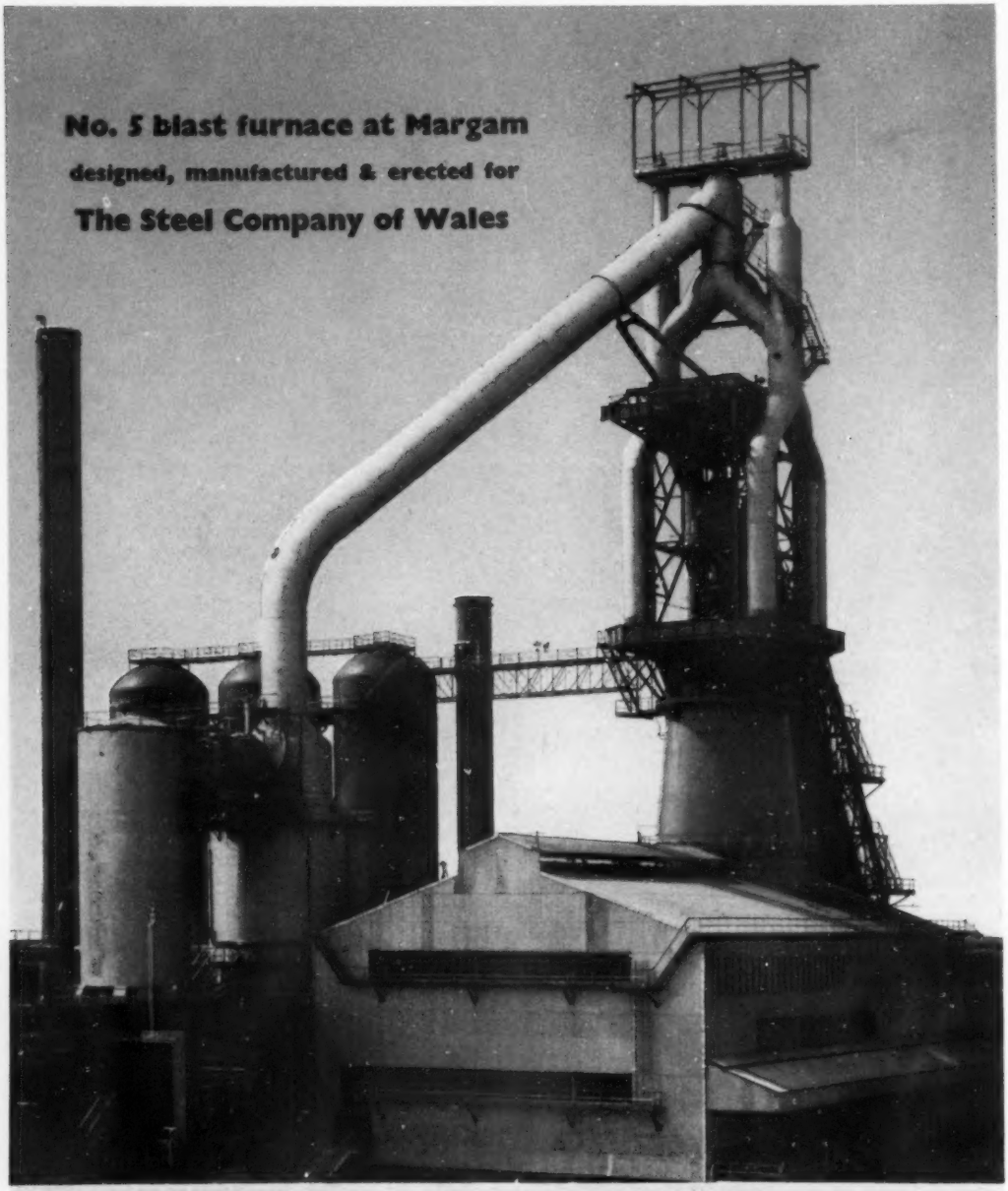

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1 **Skip discharge equipment**
2 **Dirt disposal equipment**
3 **A washery conveyor**

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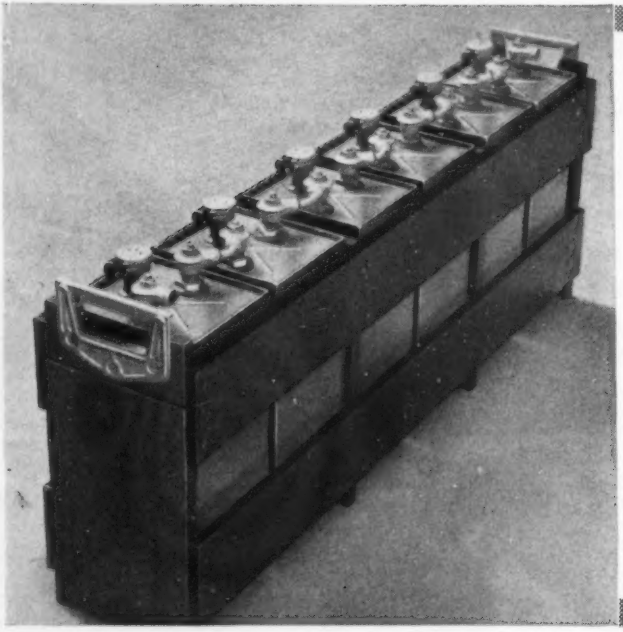

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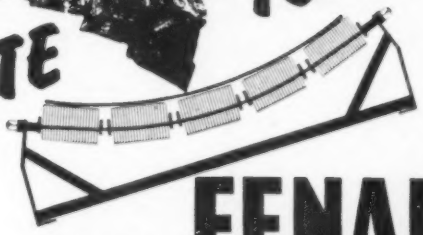

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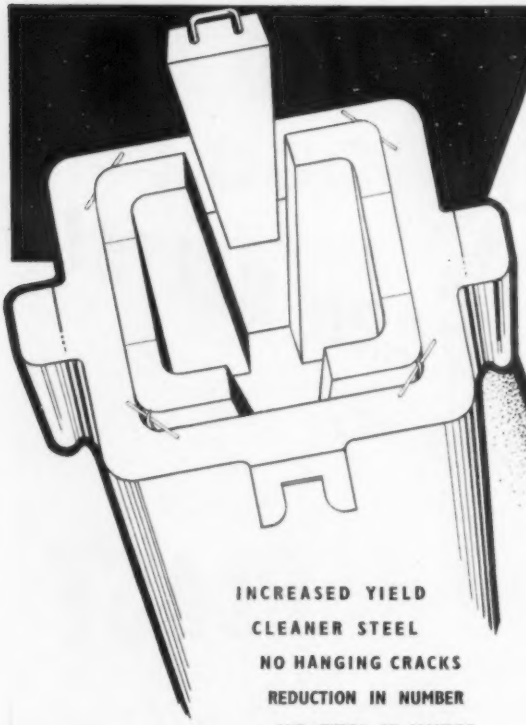

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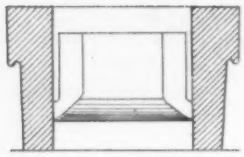

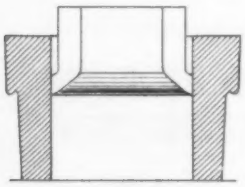

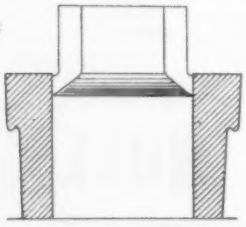

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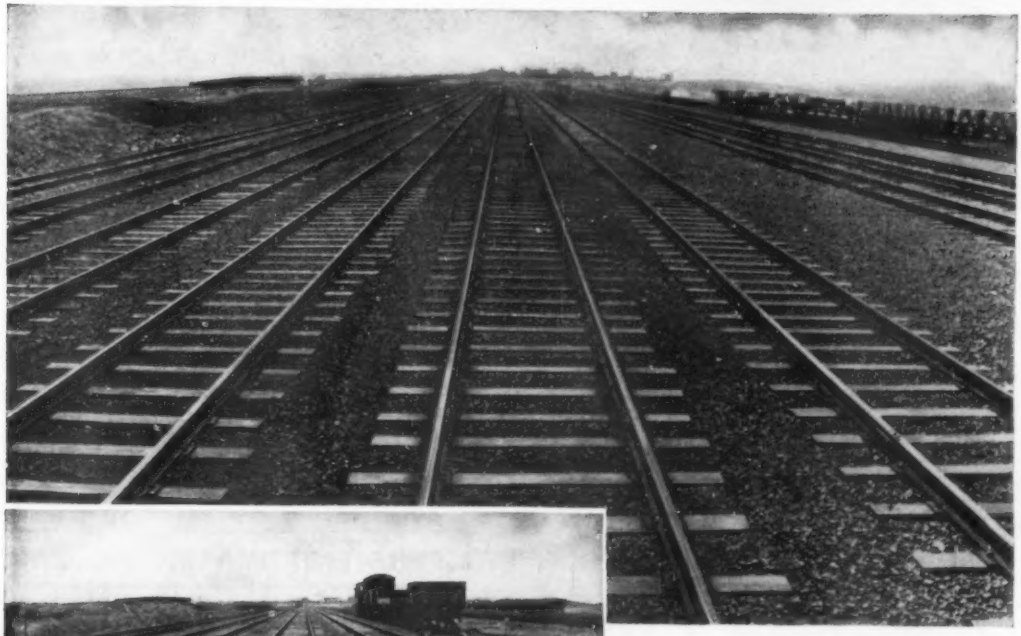

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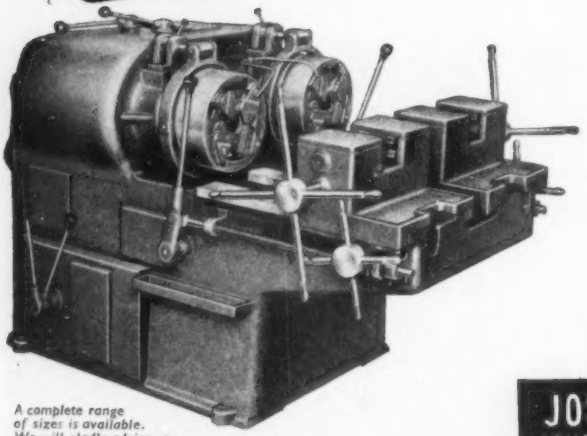

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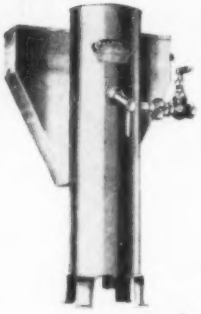

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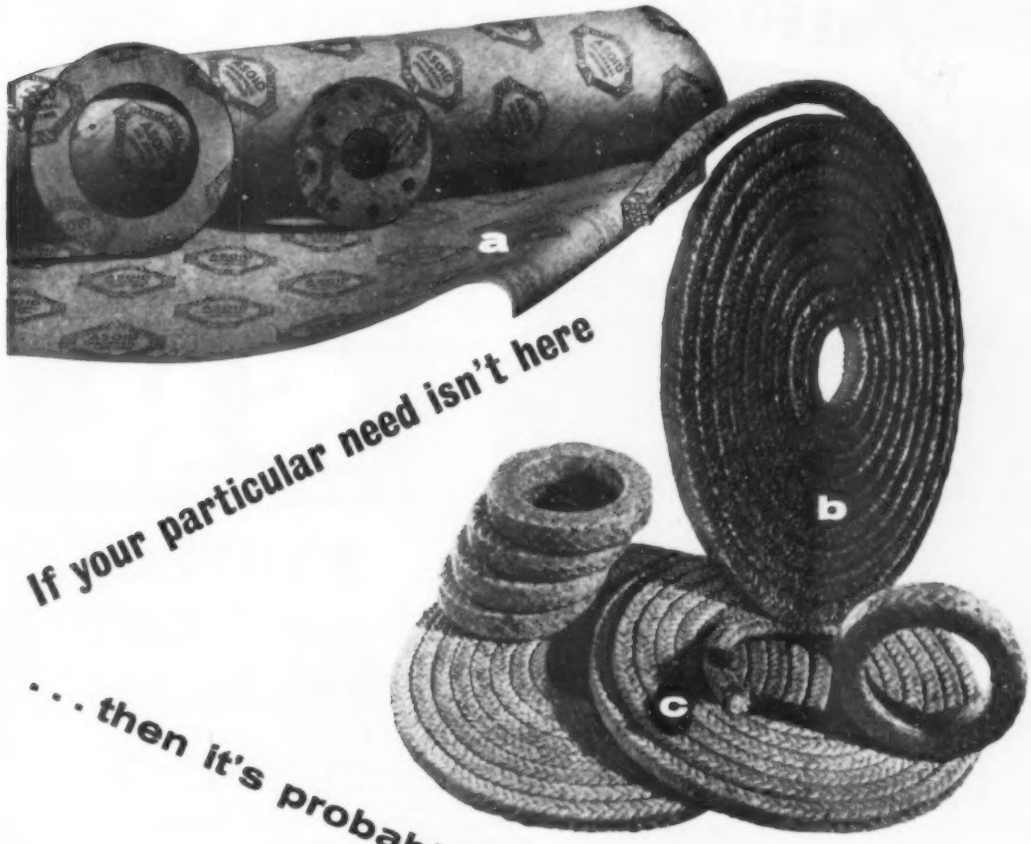

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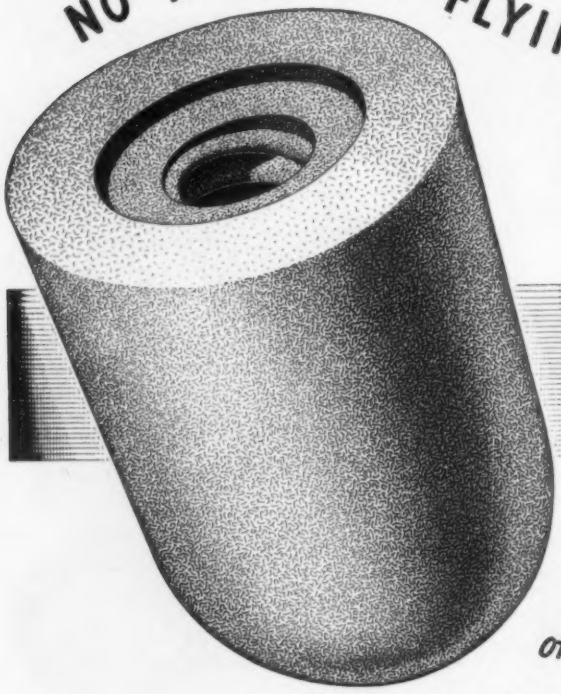

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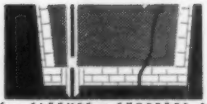

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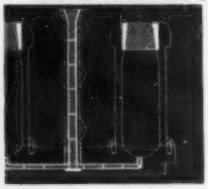

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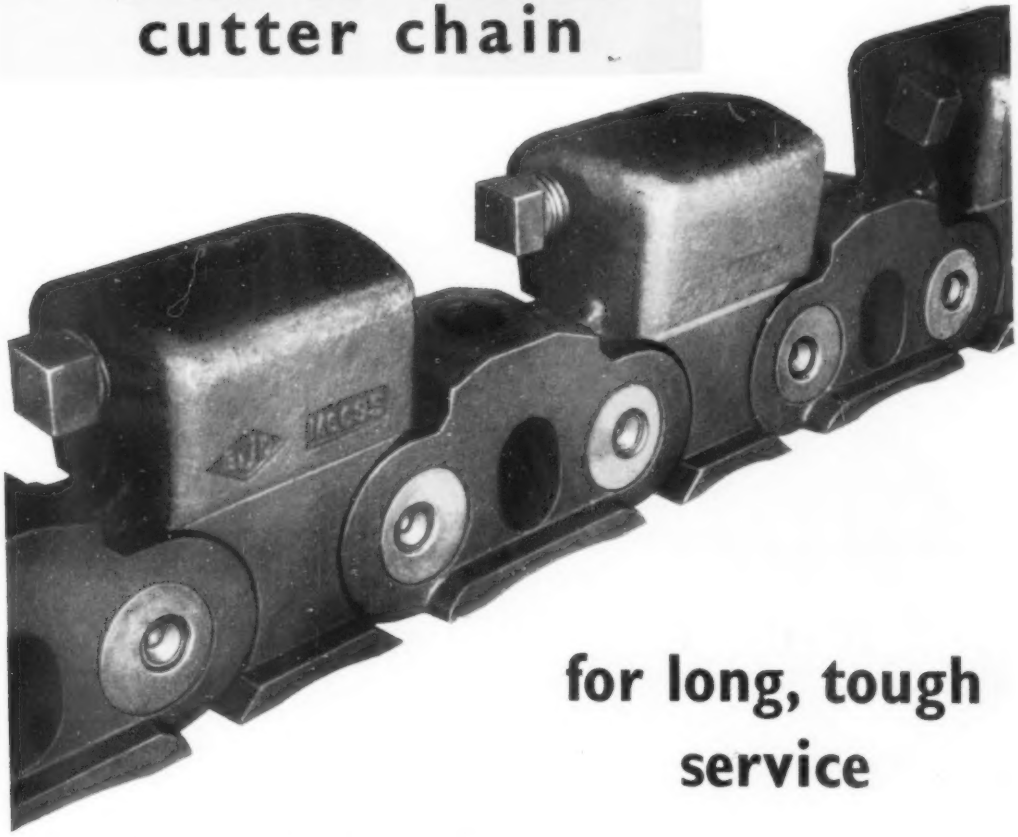
Powerline
cutter chain



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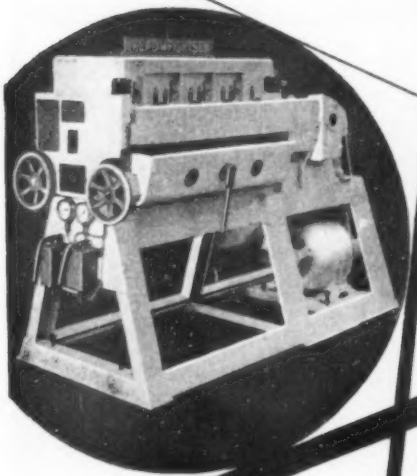
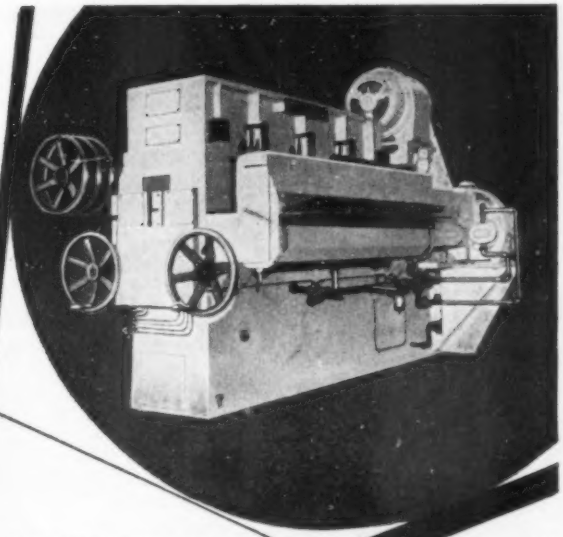
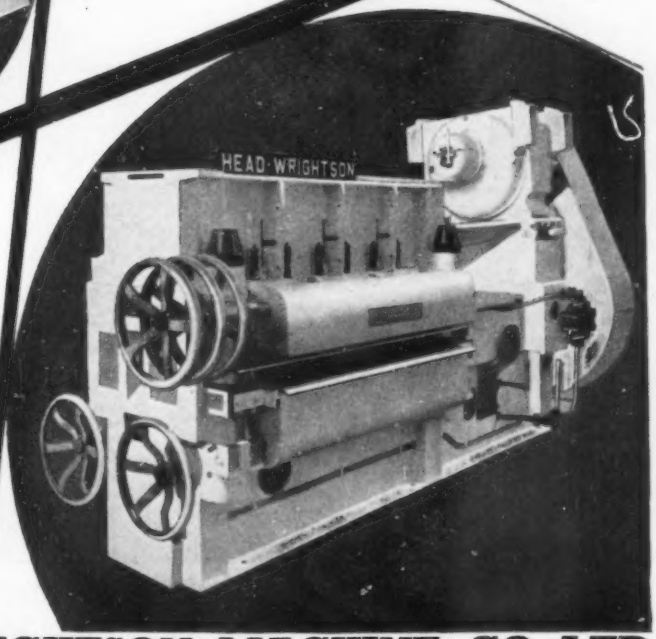
Left: 1½" Pressure Regulating Roller Leveller





Top: 1¼" Processor Leveller

Bottom: 2½" Pressure Regulating Roller Leveller



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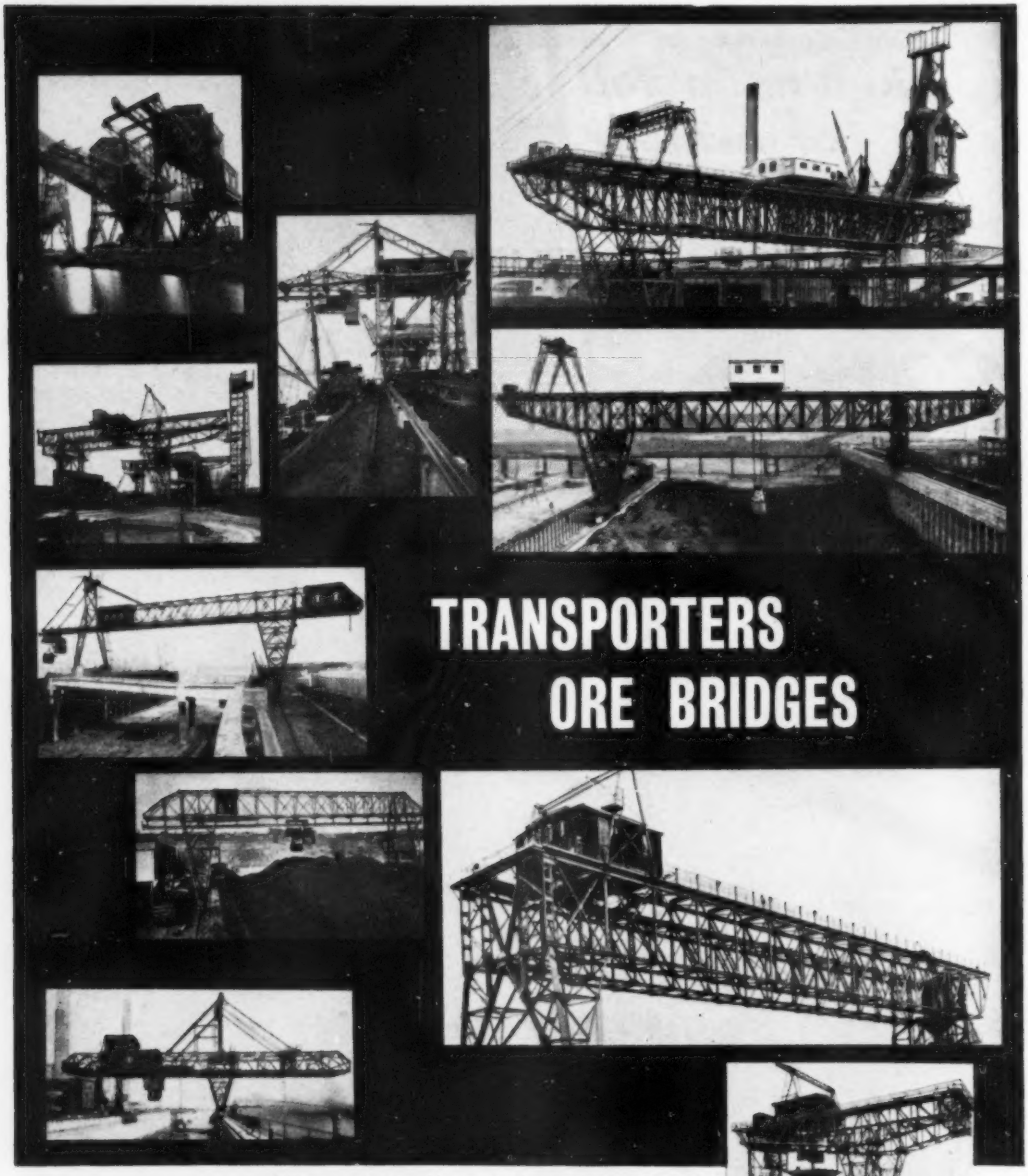

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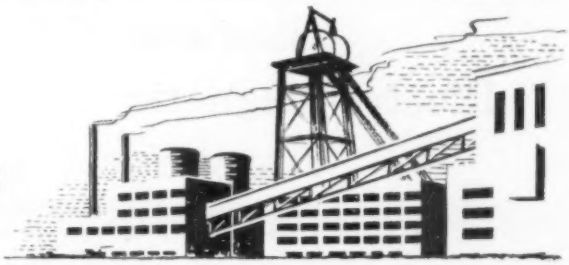

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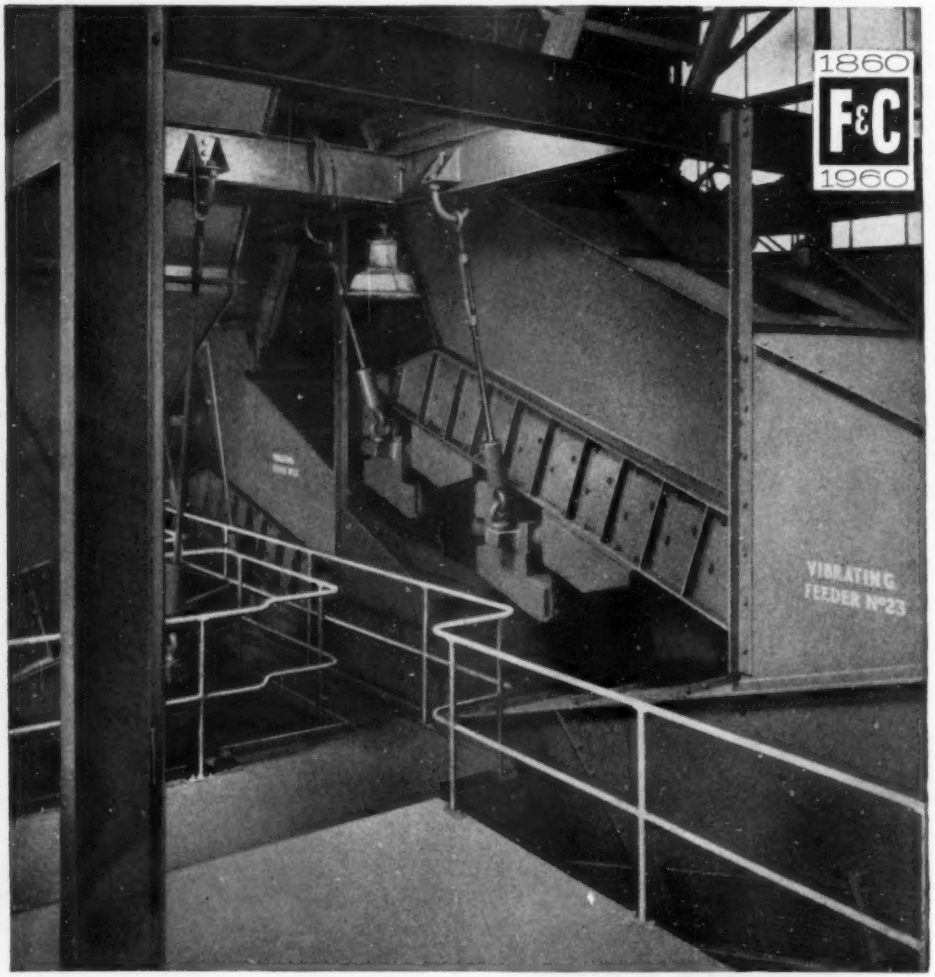

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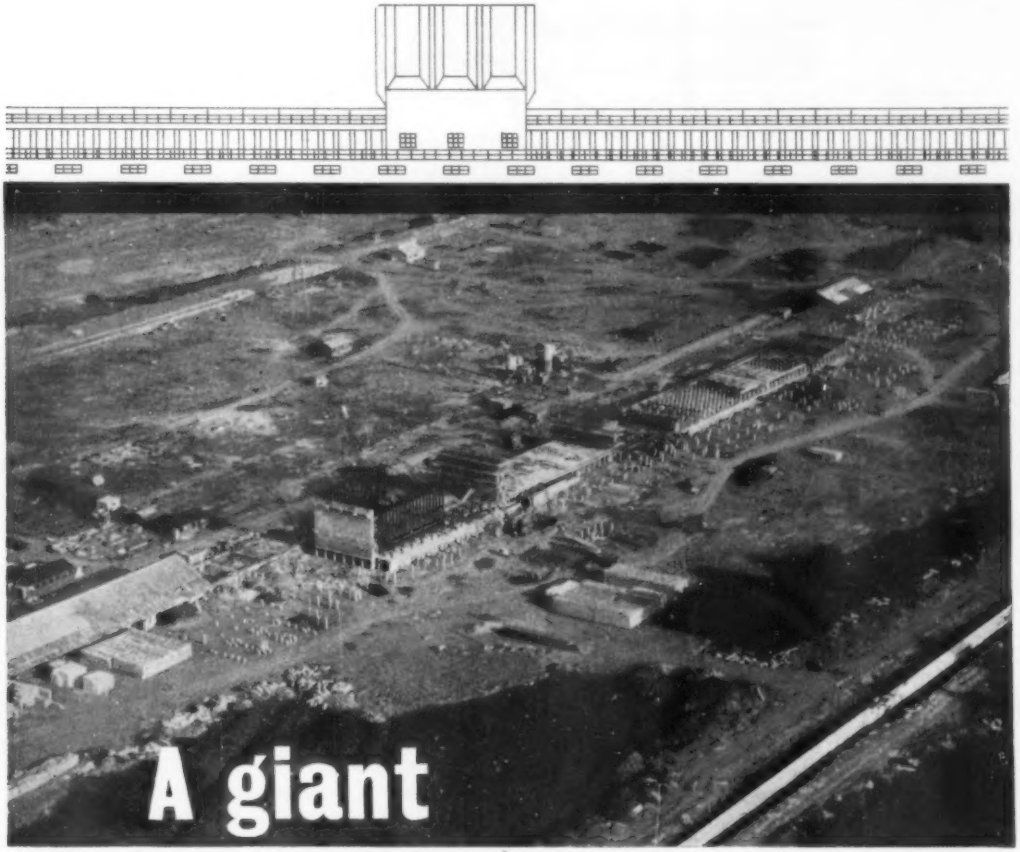

emerges

. . . . a giant whose job it will be to serve
an even bigger giant faithfully and regularly for a great many years.
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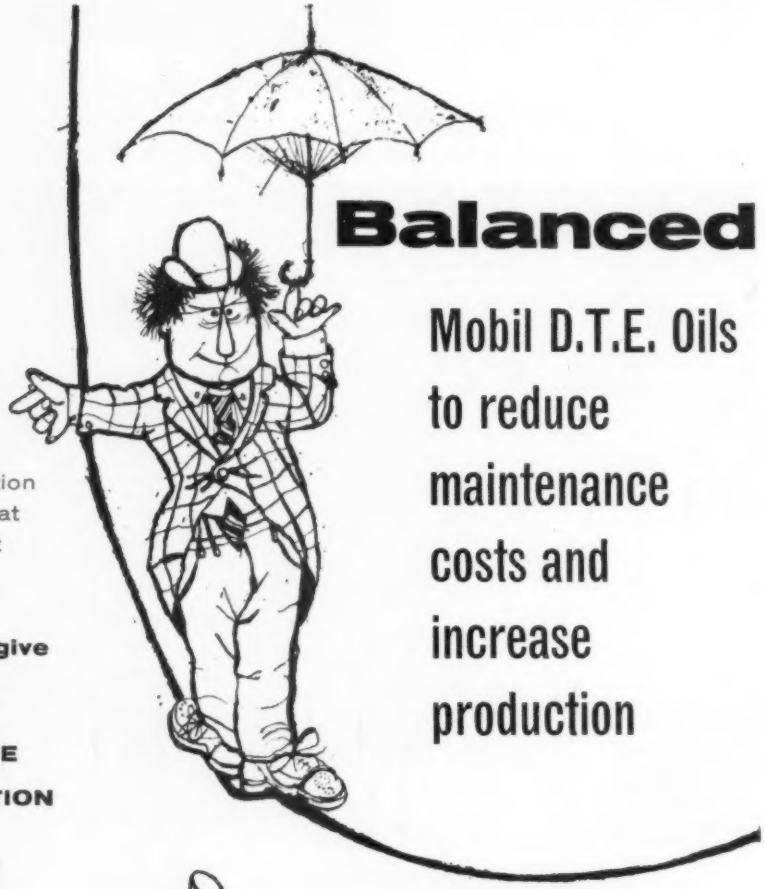

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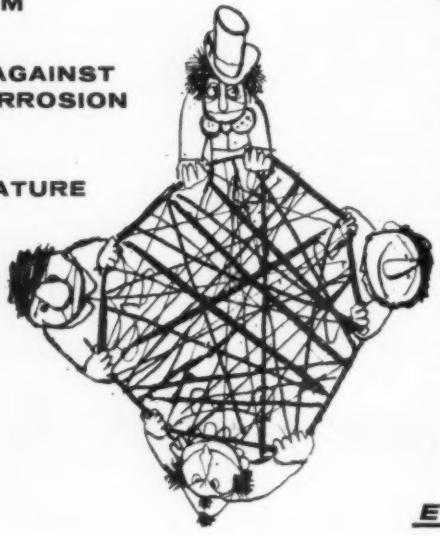

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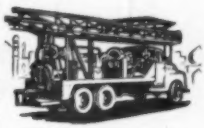
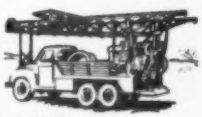


PAKISTAN



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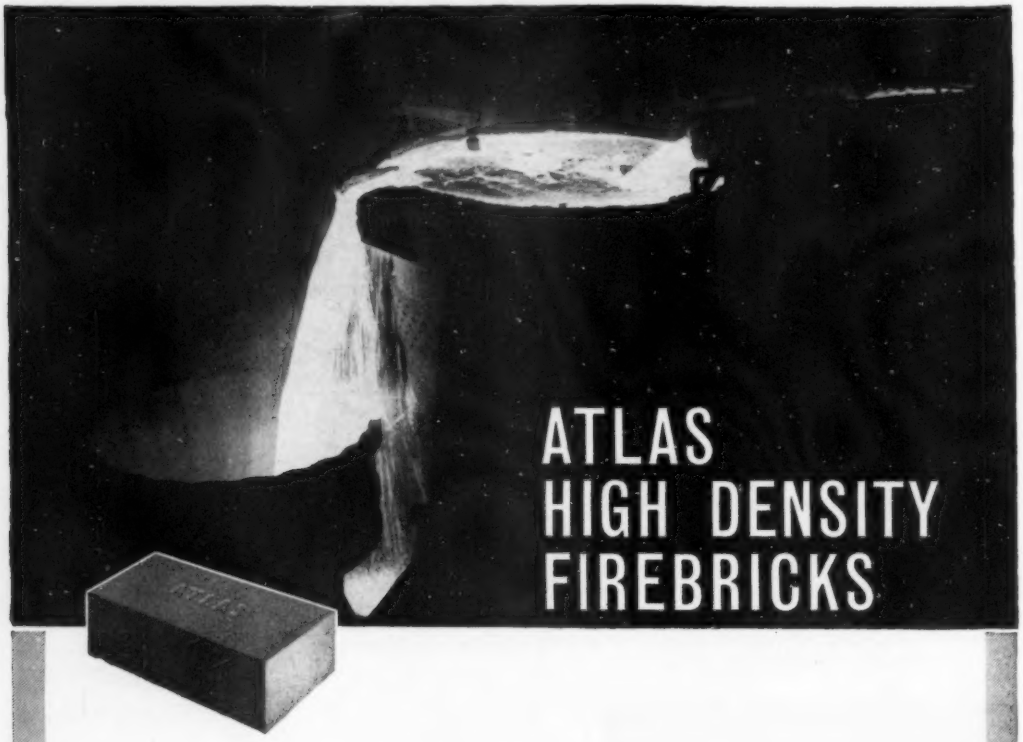

ATLAS HIGH DENSITY FIREBRICKS

No firebrick can withstand high temperatures and heavy loads indefinitely.

But **ATLAS HIGH DENSITY** Firebricks have the maximum life possible under such conditions. They have been produced specifically for ladle linings and are quite unique in their performance in bottoms and the striking areas. High crushing strength and great resistance to penetration, erosion and abrasion have been combined to ensure a long working life.

Use **ATLAS HIGH DENSITY** Firebricks and line less often.

ILLUSTRATION

Tapping a furnace at Abbey Melting Shop, Steel Company of Wales Ltd. Ladle Bottoms are ATLAS Firebricks.

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It took Comet know-how, our unrivalled technique, and the famous wedge action clench to produce a fastener whose strength matches up to the new high tensile beltings. Designed specifically for *premium* beltings, you can now use 15% more of their extra strength.

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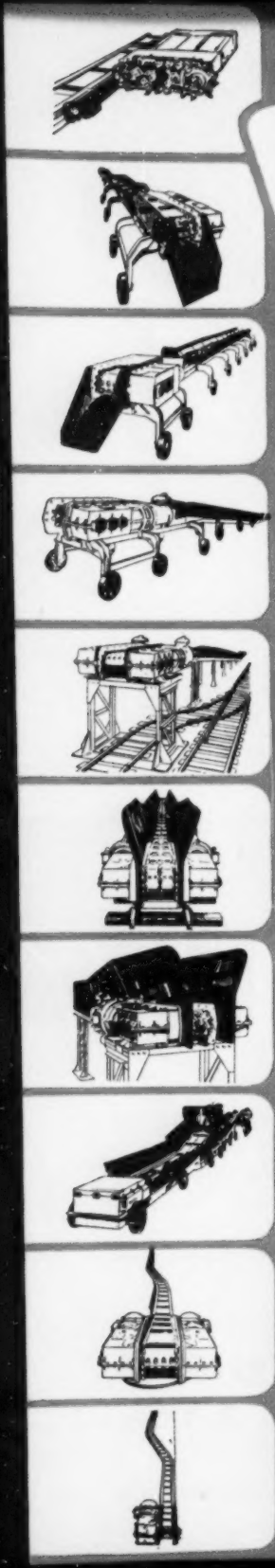

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Crawley products are of high capacity, rugged in design and low in maintenance cost. They have a high degree of standardisation and interchangeability of parts, and offer an efficient and sure solution to the conveying and power loading problems common to the longwall system of mining throughout the world.

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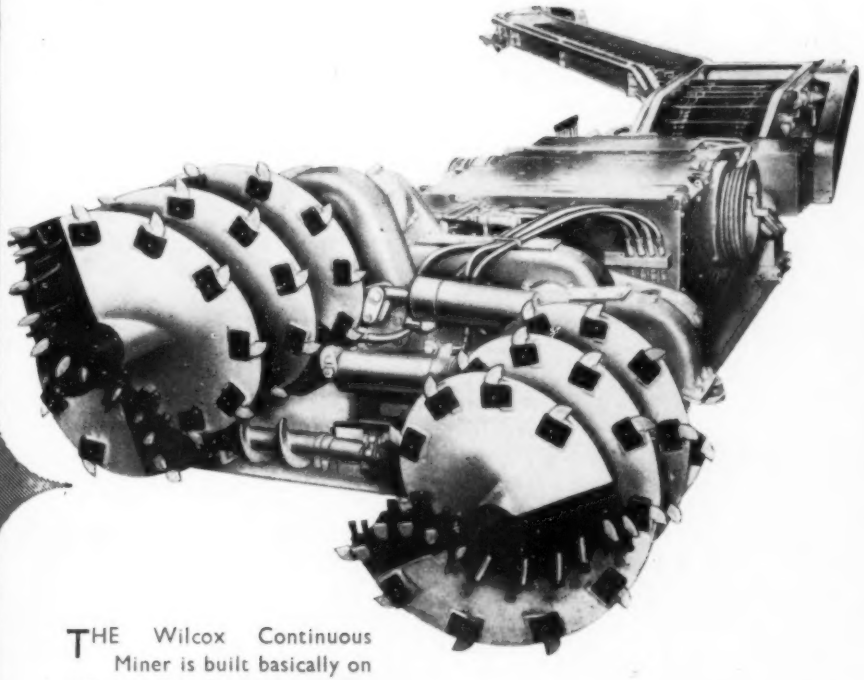
CONTINUOUS MINER



THE Wilcox Continuous Miner is built basically on a shortwall coal cutting machine chassis with two augers 41in. long and varying in diameter from 22in. upwards according to seam thickness. Each is equipped with carbide cutting picks on both front cutting edges and auger scrolls. The augers are driven through reduction gearing from the motor and rotate in opposite directions. Hydraulic controls are fitted as an integral part to both machine and conveyor.

Coal is discharged from the machine on to a bridging conveyor, which in turn discharges on to a chain conveyor. The bridging conveyor can pivot a full 180 deg. at either end, so giving maximum operational flexibility.

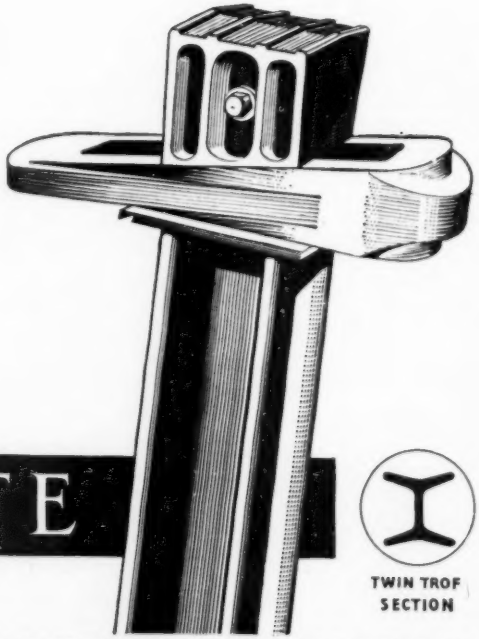
CAPACITY Results achieved to date in a seam of 36in. are as high as 300 tons per shift from an eleven-man team.

- **The lowest Continuous Miner on the market today in height, cost and maintenance.**
- **Cuts seams from 22in. to 46in.**
- **Can produce up to 300 tons per shift with two 3 men crews at the working face.**
- **Currently producing coal under roof conditions where other mechanical equipment has failed.**

MORE TONS PER MAN AT LESS COST PER TON

No loose parts to come adrift

A disadvantage of other, more complicated systems of roof control—quite apart from the cost—is loss of efficiency due to loose parts becoming lost or detached. Bathgate Wedge Props offer a reliable method of supporting the heaviest of loads, and yet are simple, light, easy to use—and the units cannot become detached.



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Blacks still lead in the design and production of the safest system of winder control and their unique knowledge and experience is always at the service of the Mining Industry.

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who have recently placed repeat orders for these reliable locomotives. Brush shunters can be specially built to meet any industrial requirements.

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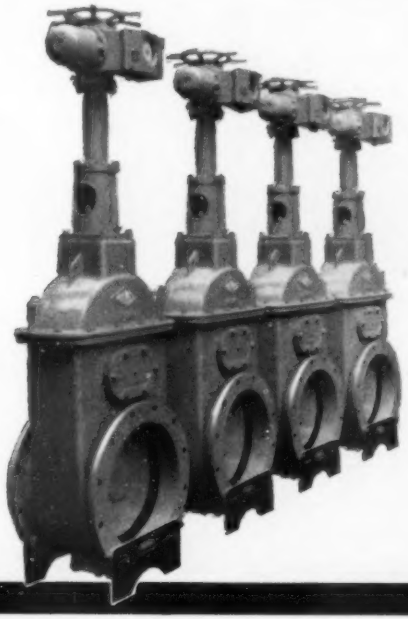
BTI2

POWER OPERATED HOLMES-WESTERN '55' GAS VALVES

Holmes-Western Valves can be arranged for semi or fully automatic operation, and can, where required, be remote controlled. All electrically operated valves are available in flame-proof, weather-proof and dust-proof designs.



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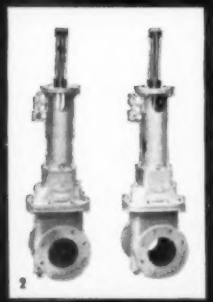

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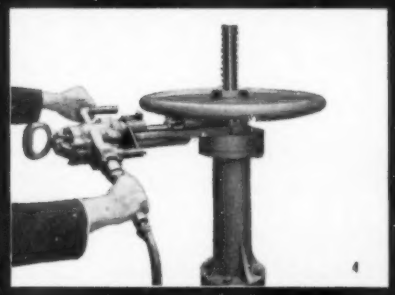

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Two valves fitted with hydraulic cylinders. Pneumatic cylinder operation is also available.

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A valve fitted with a dust-proof pull-type solenoid. This valve is designed to close automatically in the event of a power failure.

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A valve arranged for air drill operation. This semi-automatic method of operation is particularly suitable where full mechanisation is not justified.

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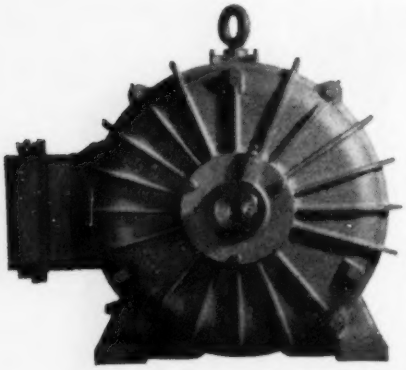
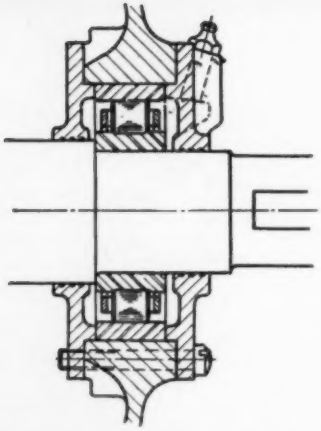


Engineers use the word performance in two senses, a limited one which refers to parameters that can be specified and checked; and a wider, vaguer, but essentially more realistic sense which covers freedom from trouble, ease of servicing, adaptability and many other things. Performance in the first sense is reproducible by any competent manufacturer; it depends on designing to well established principles. Performance in the second sense is the basis of choice between manufacturers. It comes from countless small differences in design that are based on know-how or experience.

This thing called know-how



Take for example bearings. We were amongst the first manufacturers to fit ball and roller bearings to electric motors and, in fact, they were standard equipment on our machines whilst the majority of motors still had sleeve bearings. The ubiquity of ball and roller bearings on motors today indicates how right this early choice was. There is a small but important detail in which the housings of the bearings on our motors differ from those on many others. We bore the end-shield clean through and fit two caps. The through bore allows of more accurate gauging—particularly with regard to parallelism—than a blind hole and the cost of the extra cap is in our opinion more than justified by this and by the better grease retention it makes possible.

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Makers of Electric Motors of all kinds, A.C. and D.C. Generators, B.E.T. Transformers, Switchgear, Cables, Instruments, Lamps, Lighting Equipment, Batteries, Stud Welding Equipment, Traction Equipment, Ceiling Fans.

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G612

The E.13 ELIPTEX Extra Heavy Duty Feeder, shown here, handles 450 T.P.H. of R.O.M. coal below a double tippler and discharges at right-angles on to a 42″ conveyor belt, reducing degradation to a minimum. It measures 6′ wide by 37′ long.

HEWITT-ROBINS

EXTRA HEAVY DUTY VIBRATING FEEDERS

Shown above: a typical ELIPTEX Grizzly Feeder with manganese steel liner plate and manganese grizzly bar caps, tapered in their length and depth to give a non-plugging section.

ELIPTEX VIBRATING FEEDERS ARE DISTINGUISHED BY:

• The exclusive Hewitt-Robins twin eccentric shaft vibrators • Heavy-duty construction • Simplicity of design • Low cost maintenance • Reliability under the most exacting conditions.

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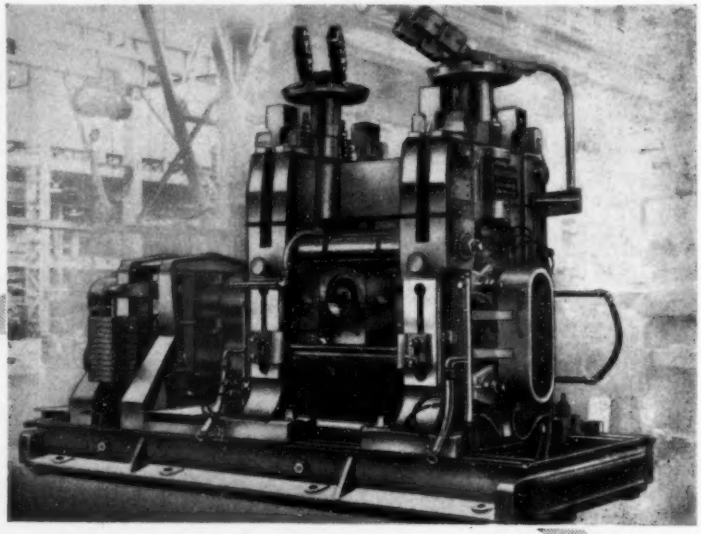
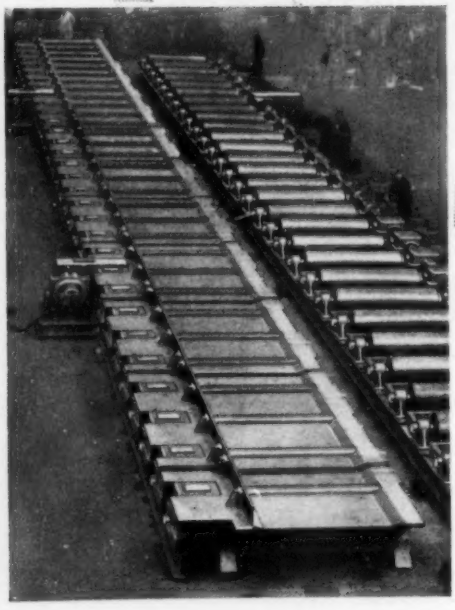


24" Section Mill Finishing Stand.

This mill and the roller tables were supplied for the DURGAPUR IRON & STEEL WORKS by—

ROBERTSON



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W. H. A. ROBERTSON & CO. LTD.,
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for their works at Hereford

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Dependability, the hallmark of Wellman Cranes, is the very essence of continued full production.

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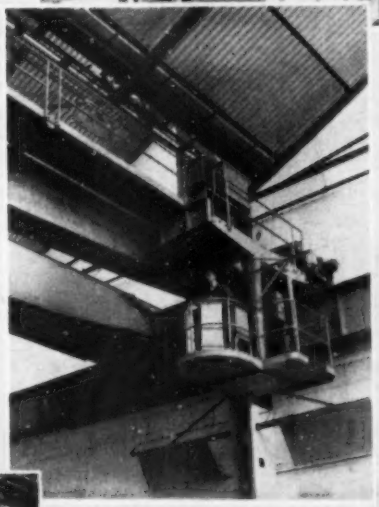

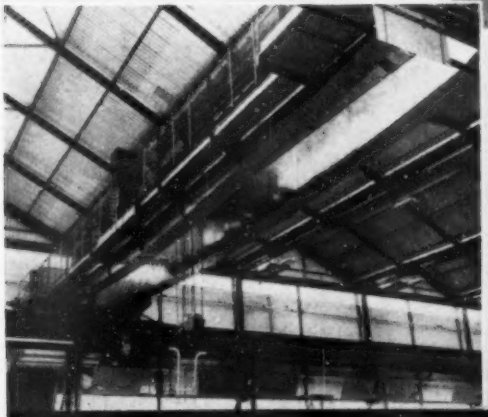

The photographs, by courtesy of Henry Wiggin & Company Ltd., show our latest box plate type girder resulting in low overall weight, high-speed travel and pleasing clean-cut design. The machine has a main hoist capacity of 15 tons, with auxiliary hoist capacity of 5 tons, has a span of 77 feet at a height of 25 feet above floor level.

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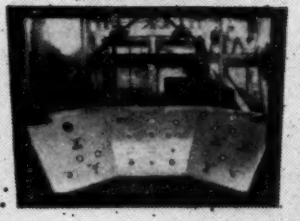

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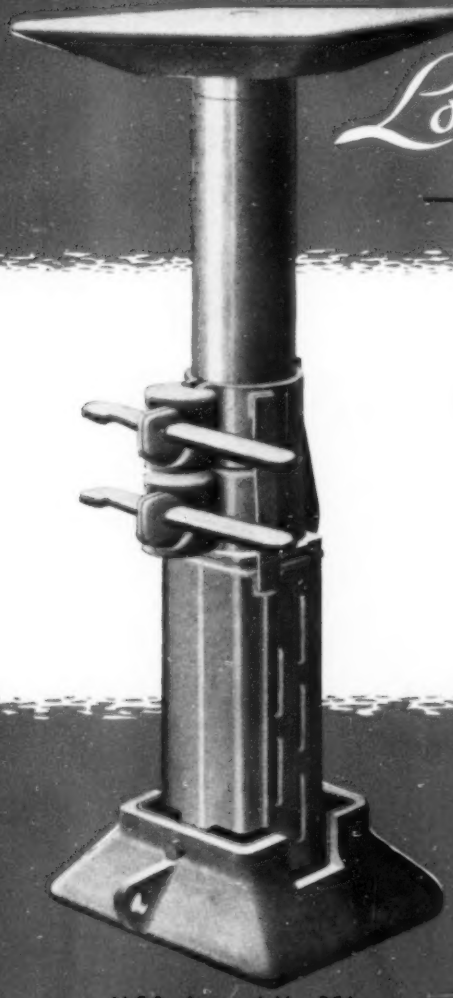

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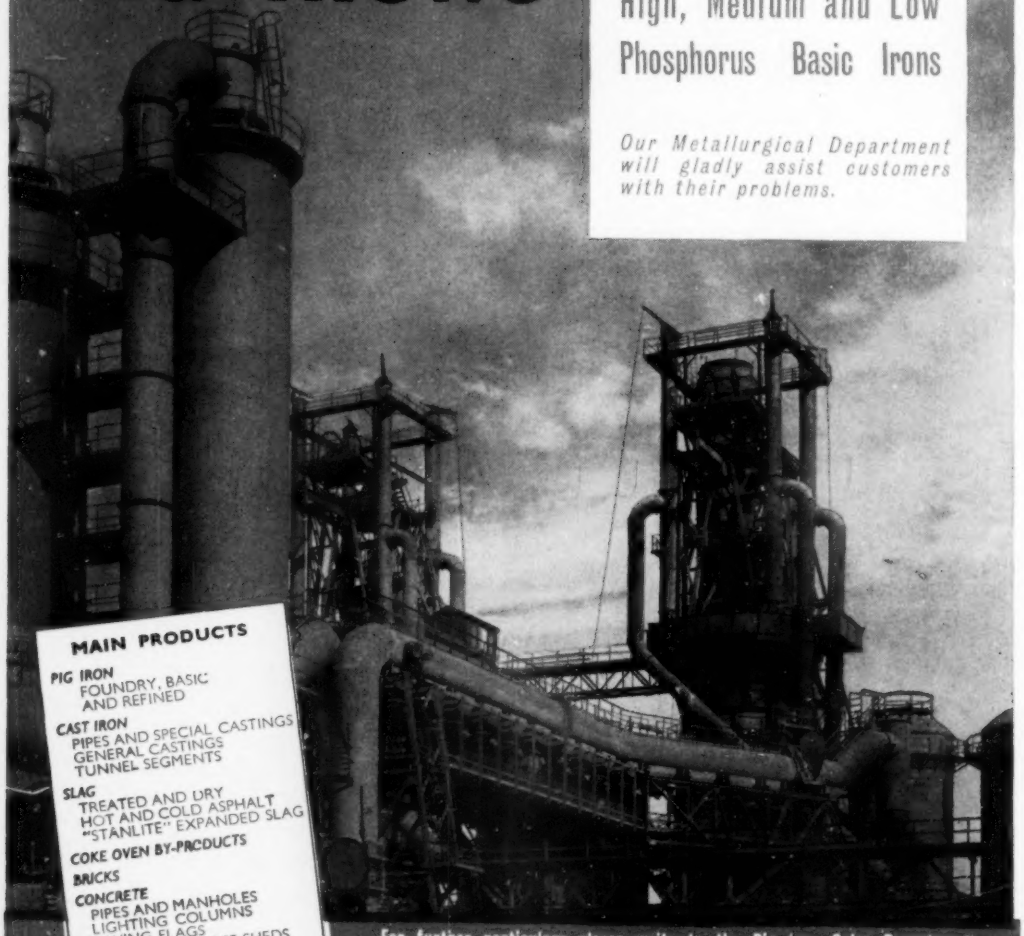

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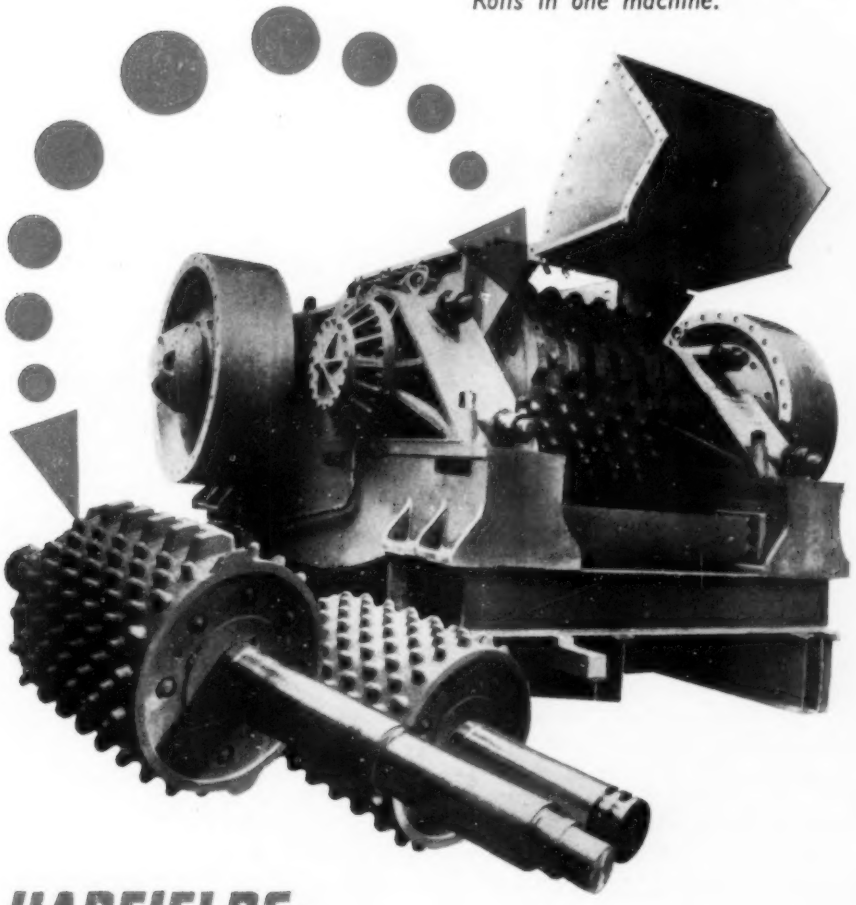

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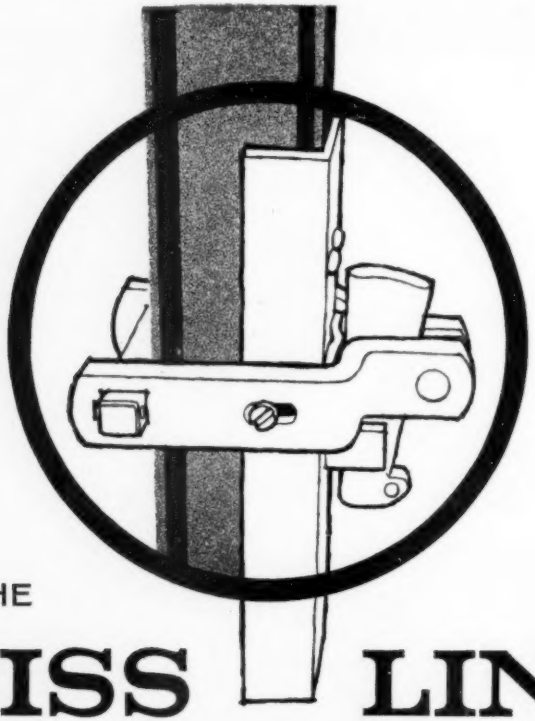

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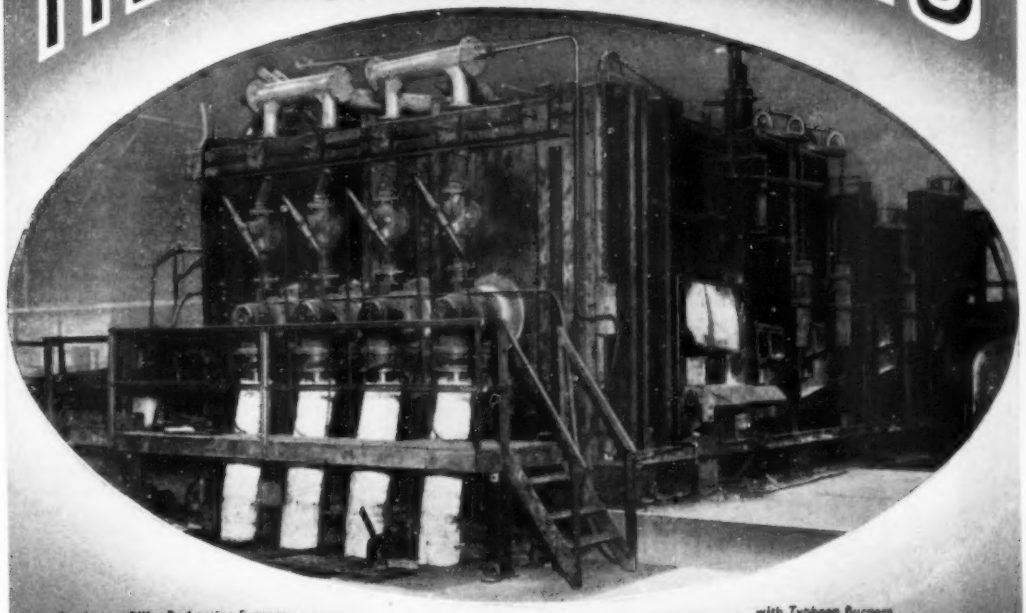

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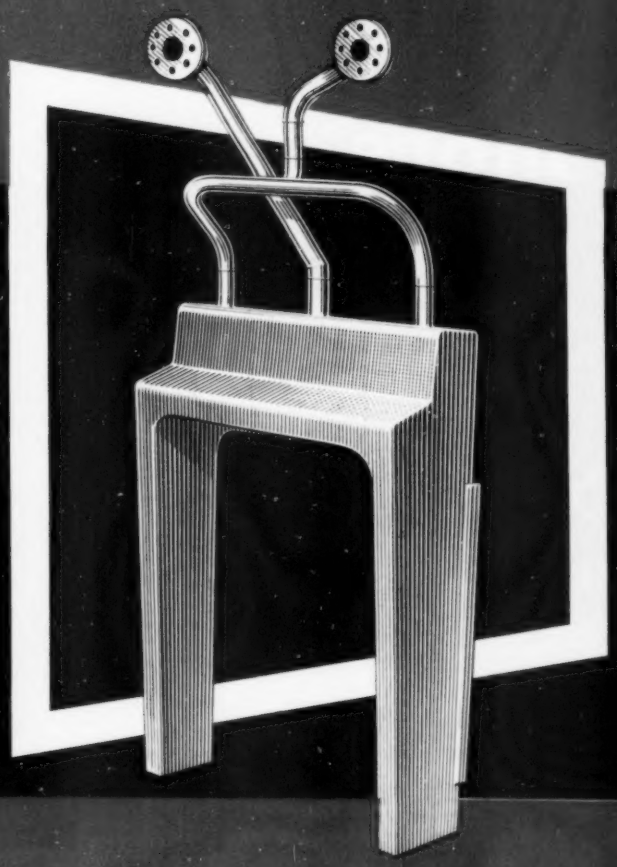

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Alumina	83%
Refractoriness — Seger Cone	– 38 = 1850 C
Refractoriness under load 28 lb./in.² (2kg./cm.²)	–5% deformation at 1660 C
After Contraction –2 hrs. at:— 1600 C	–0.40%
Apparent Porosity	23%
Cold Crushing Strength	13,000 lb./in.² (914 kg./cm.²)

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APRIL 14
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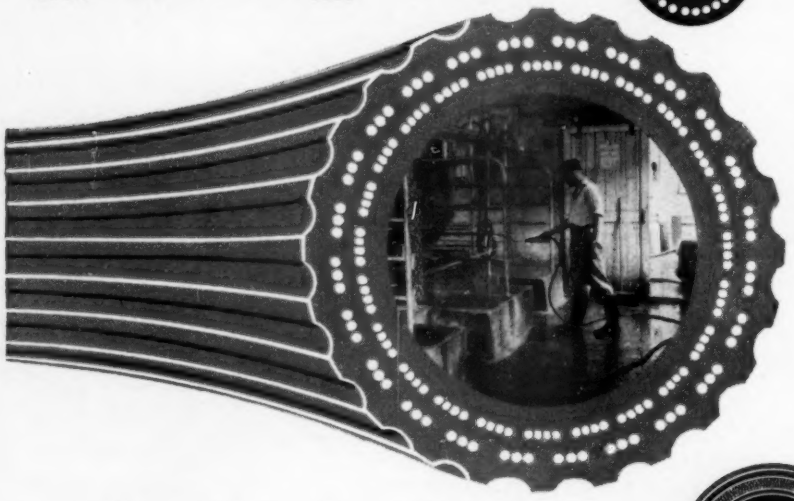
YOU NAME THE JOB WE HAVE THE HOSE



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IRON & COAL
THE IRON AND COAL TRADES REVIEW

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State Industries

THE Government's White Paper on the nationalized industries is not likely to meet with warm and wholehearted approval from all sections of the community. Those who regard such industries as coal, gas, electricity, and the railways as *quasi* social services meriting total tax support in fair weather and foul—much as we have come to regard education and health—will find the White Paper's proposals a direct blow to every principle they hold. Those in the opposite camp will probably acclaim the effort to make nationalized industries self-supporting to the extent that they are able to finance their own capital development. The suggestion that prices might be increased to enable State industries to meet financial obligations will not go down quite so well, however, with those who have to watch closely the cost of power supplies, or with telephone subscribers, and season-ticket holders who are particularly vulnerable where price increases are concerned.

The White Paper places new requirements upon the nationalized industries to improve their financial performance and so reduce their borrowings from the Exchequer. At the same time they are to have greater freedom in fixing the prices of the goods and services which they provide. There are three specific requirements:—Surpluses on revenue account should be at least sufficient to cover deficits on revenue account over a five-year period; provision is to be made from revenue to cover the excess of depreciation calculated on replacement cost basis over historic cost and for allocations to be made to general reserves which will be available for capital development and as a safeguard against premature obsolescence and similar contingencies; and each industry is to be set a financial target to achieve in the next five years, beginning with the start of the next financial year in each industry. Within the next few months the Government will settle these targets with the nationalized boards, taking account of uneconomic services provided for social and strategic reasons, and there will be an opportunity for a review each year " in the light of events inside and outside the industry."

A clearer definition of the financial obligations on each board is aimed at, the Government wishing to persuade the boards to improve their performance and their reserves, and to increase their independence and self-discipline. The implication that prices may be increased is too obvious to be avoided, but the Government believes that savings can be made in many other ways; for instance, more ruthless action could be taken to prune uneconomic activities. For its part the Government gives the undertaking that it will not intervene in the boards' price-fixing policies unless there are very exceptional circumstances.

The Government policy is to ensure that the industries are organized and administered efficiently and economically and it is emphasized that " although they have obligations of a national and non-commercial kind, they are not, and ought not to be regarded as social services absolved from economic and commercial justification."

The danger of comparing State and private industries is not overlooked and it is pointed out that a simple comparison with the return on capital in private industry—about 15 per cent. in the past few years—and the 5 per cent. of most nationalized industries would be misleading. Nor has the part played by nationalized industries in keeping prices stable been ignored. The pressure from public opinion on the boards to keep prices down when costs and prices had been rising elsewhere is acknowledged. " In this way," the White Paper states, " they have contributed substantially to efforts to stabilize prices and their own financial position, as reflected in the return on their capital, has suffered in consequence."

There is a risk that too much of the nation's savings will be diverted into the nationalized industries; and, again, if the prices of the goods and services which they provide are uneconomically low, demand for them (and for investment to produce more of them) may be artificially stimulated. Thus the operation of the nationalized industries with an unduly low rate of return on capital is sooner or later damaging to the economy as a whole.

The new financial targets for the boards will not be constricted into one standard formula, but " the State, as owner or guarantor of the capital of the nationalized industries (which are investing over £800,000,000 a year, more than half of which comes from the Exchequer) would expect capital employed in this kind of business to earn a higher rate of return than the cost of the money to the Exchequer." In other words, the objective for each industry will be determined in the light of its own circumstances.

The Government intends each year to discuss with each board the general lines of its plans for development and capital expenditure for five years ahead and, each year, will fix an upper limit on the amounts to be spent on investment during two years ahead, being kept informed of capital investments

in projects which are expected to yield a relatively low return. Inability or prospective inability to meet the requirements of the Government would lead to closer investigation by the Minister responsible, and the board concerned would be required to propose specific measures for righting the situation.

These are some of the objectives set out in the White Paper and, until the Government has made up its mind how far it requires an undertaking to operate commercially, it is impossible to assess the effect on the industries concerned. But at least the White Paper will serve to bring its own "wind of change" into State-owned concerns and in so doing, it is quite possible that not only defects will be highlighted, but also some of the valuable and important services that have been rendered to the nation by the nationalized industries may come in for their due meed of praise.

New Credit Measures to Aid Exporters

IMPROVEMENTS in the method of financing and insuring British exports through the Export Credits Guarantee Department were announced by Mr. Reginald Maudling, President of the Board of Trade, in the Commons on Wednesday. The improvements are in three parts, the first of which is that premium rates for ECGD insurance are being reduced; the main benefit of these reductions will be felt in those export markets where the highest rates are at present charged, and the effect will be to cut the total amount of premiums charged by about a quarter.

Secondly, ECGD is introducing an entirely new system by which the department will guarantee loans made for periods longer than five years by financial institutions in the City of London to "creditworthy oversea purchasers." Broadly speaking, these new guarantees of long-term loans are designed to help exports of large capital projects normally costing over £2,000,000, such as power stations, steel mills, pipelines, industrial plants, and ships.

Finally, ECGD has designed what it describes as a simplified "small exporter" guarantee. This will be available from the beginning of next month to all firms whose export turnover has been less than £10,000 a year in recent years. It will provide 90 per cent. cover against loss on all export business for a flat rate premium of 15s. per £100 insured. This new simplified guarantee is aimed at encouraging small firms to start exporting, or to export on a bigger scale; it will cease to apply to firms initially eligible either after two years or when their insured export turnover has reached £20,000, whichever is earlier.

FOLLOWING STUDIES being carried out by the US concern, Koppers Company, it is planned to triple the capacity over the coming years of the Colombian steelworks Acerías Paz del Río. The works last year achieved a record production of 98,700 metric tons of finished steel goods. By the end of the planned expansion programme, output is aimed to reach an annual level of some 275,300 tons of finished steel goods.

Passing Thoughts . . .

ONE must identify any oversea subsidiary company or factory completely with the country in which one intends to set it up. It is no use settling down in another country and trying to run the business entirely to British rules. . . . Success in oversea markets is not merely a matter of salesmanship and nothing else. It is a two-way traffic, and the newcomer must be prepared to give as well as to take.—MR. JOHN OLDHAM, chairman of Oldham & Son, Limited, battery manufacturers, etc., of Manchester, presiding at the Northern conference of the British Institute of Management.

> *Free trade is theory only. It has never been tried. Our approach to it led us to* 1931. *We are heading once more for that situation if we neglect the portents.*—MR. W. A. WELLS, *director of the Commonwealth Industries Association, in a letter to the Financial Times.*

It is to the credit of Mr. Alfred Robens that he should set out so energetically to sell coal in competition with other fuels. This approach will impress the public far more than the sort of appeal put out by the mineworkers and the Labour Party for protective measures. In the long run coal must find its natural place by the age-old test of consumer demand.—The Scotsman.

> *It would be interesting to know whether the Coal Board has considered the probable cost of its proposal to sell coal on "easy terms." Expenditure on clerical labour and collectors will soon wipe out any question of profit.—Letter in the Financial Times.*

For all the cavilling at the coal industry for its mountainous stockpiling of coal in the past, the speed with which this erstwhile incubus is being reduced suggests that it may be possible to have too much of a good thing. . . . The industry has, of course, a long way to go to get stocks down to a normal level of reserves as protection against seasonal contingencies. But rather more consumption is being met from stocks than may be good for the industry.—Daily Telegraph.

> *An infectious optimism about the future of the coal industry is manifested by Mr. Alfred Robens. . . . He combines bold ideas and imagination with moral courage and energy. He is building on and extending logically the splendid work Sir James Bowman did in difficult conditions.—Newcastle-upon-Tyne Journal.*

When coal can be delivered in large quantities in, say, cartons, so that the periodic raising of clouds of black dust around the house can be avoided, the [Coal] Board will win the approval of their patrons. But it is difficult to see how . . . the labour of cleaning up fireplaces can ever be abolished. Many housewives have gone on strike against it; we suspect that many more will do so.—Glasgow Herald.

> *Better be bloody, bold, and resolute than timidly trying never to be unpopular, never to lose a vote anywhere, never to go against the masses. The British people—of whom the trade unionists are one third, with their families—always respect leadership, guts, firmness, and a good dash of eccentricity.*—GRAHAM HUTTON, *speaking at a meeting of the British Institute of Management.*

BRITISH ALUMINIUM COMPANY, LIMITED—Mr. P. J. Prior has been appointed to the board and will take up his duties as financial director from May 1.

Steel Output Fall

TEMPORARY WEAKNESS IN SHEET AND TINPLATE DEMAND

PRODUCTION of crude steel in the UK during March was at an average of 471,000 tons a week, compared with 485,300 tons a week in February and 485,100 tons a week in March, 1960, the Iron and Steel Board stated yesterday (Thursday). Most of the fall in output compared with a year ago took place in North and South Wales, where the works were particularly affected by the temporary weakness in demand for sheet and tinplate.

Total production of steel in the first quarter of the year amounted to 6,210,000 tons (compared with 6,240,000 tons in the first quarter of 1960), and is equivalent to an annual rate which, for the time being, is at the lower end of the production range of 24,000,000 to 25,000,000 tons suggested for 1961 as a whole in the board's production statement for November, 1960. Output of pig-iron in the first quarter was 4,011,000 tons compared with 3,957,000 tons last year.

The board says there are signs that the renewed activity in the motor industry is promising a revival in ordering for products such as steel sheet, which have recently been affected. Exports of steel during the first two months of the year were at an average of 259,000 tons a month, in line with the expectation of a further rise in exports above last year's improved level. Imports of steel during the period, at 52,000 tons a month, were well below the average rate for 1960.

Latest pig-iron and steel output figures (in tons), with the corresponding 1960 returns, are shown in the following table:—

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1961—January ..	308,500	16,040,000	478,400	24,876,000
February ..	302,400	15,727,000	485,300	25,236,000
March ..	313,500	16,301,000	471,000	24,490,000
1st Quarter..	308,500	16,044,000	477,700	24,838,000
1960—January ..	297,500	15,470,000	471,400	24,511,000
February ..	301,500	15,680,000	482,200	25,073,000
March ..	312,300	16,238,000	485,100	25,226,000
1st Quarter..	304,400	15,830,000	480,000	24,959,000

Morgan Crucible Reorganization

FROM April 3 the Morgan Crucible Company, Limited, London, S.W.11, became a holding company and its responsibilities for production, trading, research and development have been assumed by the following five new wholly-owned subsidiaries:—

Morganite Carbon, Limited, London, S.W.11, managing director, Mr. C. S. Harris; Morganite Crucible, Limited, Norton, Worcester, managing director, Mr. D. S. S. Thynne; Morganite Electroheat, Limited, London, S.W.18, managing director, Mr. I. Weston Smith; Morganite Research & Development, Limited, London, S.W.11, managing director, Mr. J. Walker; Morganite Exports, Limited, London, S.W.11, managing director, Mr. J. H. Baumann.

£6,000,000 Expansion Plan by GKN (South Wales)

NEW wire nail factory to be built at Cardiff is a major part of a £6,000,000 development plan to be undertaken by Guest Keen & Nettlefolds (South Wales), Limited. It will raise the firm's output of steel products by a half to 900,000 tons a year. The factory is to be built near the company's rod mill at Tremorfa, on the former Pengam Moors airport site. Automatic machines for manufacturing the nails will be transferred to the new factory from the company's Castle Works in Cardiff. The capacity of the new plant will exceed 50,000 tons of wire nails a year, and work on the site is already being carried out.

Under the development plan, a new 16 in. re-rolling mill to increase the output of hot rolled bars and sections by 150,000 tons a year is to be installed at the Tremorfa works. Two hand-operated mills which have a low output will be replaced by a small, modern re-rolling mill.

The company has decided to go ahead with a scheme announced a year ago for increasing the capacity of the Tremorfa rod mill by 40 per cent. to 350,000 tons a year. It will make the mill one of the most up-to-date and efficient plants of its kind in the world. It is also planned to increase wire drawing capacity at Castle Works by 40,000 tons a year, and new plant is to be installed for making reinforcing bars.

The development scheme is the largest to be carried out since the company moved to Cardiff about 30 years ago.

Rise in Iron Ore Imports Through South Wales Ports

IMPORTS of iron ore through the South Wales ports during the four weeks ended March 26 increased by 27,000 tons over the corresponding period in 1960. Imports of other ores, however, fell by 3,000 tons, and there was also a fall of 3,000 tons in imports of pitwood and mining timber. Exports of iron and steel manufactures rose by 20,000 tons, while exports of coal, coke, and patent fuel fell by 26,000 tons and those of tinplate by 8,000 tons.

Total traffic passing through the various ports during the period, with the corresponding figure for 1960 in parentheses, were:—Newport, 184,148 (175,179) tons; Cardiff, 182,756 (230,518) tons; Barry 85,370 (123,542) tons; Port Talbot, 283,042 (215,990) tons; Swansea, 436,637 (671,302) tons; Penarth, 22,744 (31,271) tons; Lydney, 2,444 (3,284) tons.

Personal

After 41 years with Smith's Dock Company, Limited, latterly as yard manager, Mr. ALEXANDER BOWMAN has retired.

Mr. L. DOBSON has been elected chairman of the Northern Counties branch of the Institution of Structural Engineers.

Mr. W. ERNEST JONES, former president of the National Union of Mineworkers has been appointed a member of the British Egg Marketing Board.

In recognition of his 41 years' service with Hunt Bros. (Oldbury), Limited, ironfounders and engineers, Mr. T. G. HUNT, managing director, has been presented with a gold watch.

Mr. W. W. M. TREES, assistant works manager for the past three years at the Britannia Works, Middlesbrough, of Dorman Long & Company, Limited, has retired. He is 65, and joined the firm 51 years ago.

Dr. JOHN LAMB, assistant director of the department of electrical engineering in the Imperial College of Science and Technology since 1958, has been appointed to the James Watt Chair of Electrical Engineering at Glasgow University.

Chairman and managing director of the Tempered Spring Company, Limited, Sheffield, Mr. GERARD YOUNG is on a visit to America to see distributors for various company products, including automobile and agricultural springs.

Mr. DONALD M. ROBERTSON, technical service engineer, of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield, retired recently. He joined the company in 1939 as works manager in the light castings department.

Mr. J. TREVOR WILSON, director of Samuel Wilkinson & Sons, Limited, manufacturers of refractories, glazed ware, etc., of Elland (Yorks), has been adopted as prospective Parliamentary Liberal candidate for the Pudsey Division of Yorkshire.

Address of the honorary secretary of the Midland Counties Institution of Engineers has been changed to: Mr. T. F. BAMBER, Midland Counties Institution of Engineers, c/o National Coal Board, East Midlands Division, Sherwood Lodge, Arnold, nr. Nottingham.

Chairman of Perkin & Company, Limited, paper tube making and cutting machinery makers, of Leeds, Mr. JOHN WILLIAM PERKIN, will be 90 on Sunday. He started his career as a machinery merchant, and in 1908 joined the family firm founded by his grandfather in 1860.

Mr. GEORGE CADWALLADER, a representative for the East Midlands Divisional Coal Board since nationalization, has retired. He is a member of a family which had close associations with the New Bagworth Coal Company, Limited. He will be succeeded by Mr. DENNIS MARVIN.

Mr. NORMAN FISHER, principal of the Staff College of the National Coal Board since 1955, is to resign his appointment in the autumn to join the board of Macdonald & Company (Publishers), Limited. Mr. Fisher is well-known as the chairman of the BBC television's "Brains Trust."

Headquarters chief superintendent at the Farington (Lancs), engine factory of Leyland Motors, Limited, Mr. C. H. RIMMER is retiring after 51 years' service with the company. Sir Henry Spurrier, present chairman and managing director, once served as a student apprentice under Mr. Rimmer.

After 41 years' service with Associated Electrical Industries (Rugby), Limited (formerly the British Thomson-Houston Company, Limited), Mr. H. L. SATCHELL, director of manufacture, retired last week. During his apprenticeship with BTH, Mr. Satchell was awarded a BTH Fellowship which enabled him to spend a year with the General Electric Company in the US. He was appointed manager of the Rugby works in 1945 and to the board in 1949. He became director of manufacture in 1957.

Mr. A. H. BUTLER, safety publicity officer to the United Steel Companies, Limited, and Mr. A. CLIFFORD, safety officer at the Appleby-Frodingham Steel Company, branch of United Steel, are to visit Australia shortly to study safety techniques and publicity at steelworks owned by the Broken Hill Proprietary Company, Limited.

Mr. WALTER WOODFORD, secretary of the Institution of Production Engineers, is to address the conference to run concurrently with the National Industrial Production Exhibition in Toronto next month. He will speak on "International Co-operation for Productivity in the Future." While in Canada he will explore the possibility of establishing a new section of the IPE in Montreal.

Yorkshire Coalfield Sites for New Power Stations

TWO sites, both on the eastern fringe of the Yorkshire coalfield, have been chosen for coal-fired power stations, the Central Electricity Generating Board announces. Each site is considered suitable for a power station of about 2,000,000 kW capacity, burning about 5,000,000 tons of coal a year. One is an extension of the board's existing site at Ferrybridge, where two stations with an aggregate capacity of 470,000 kW are now in operation. The other is at Eggborough, four miles east of Knottingley.

A third site, on the river Aire at Gowdall, to the east of Eggborough, is believed to be potentially suitable for a station, to meet later growth of demand, if water cooling problems are solved.

Further investigations are also required into the problems of a station on the river Don additional to the 1,100,000 kW Thorpe Marsh station now under construction. The National Coal Board is siting a 1,000,000-tons-annual-output colliery near Eggborough.

New President of AMEME in North Staffordshire

NEW president of the North Staffordshire branch of the Association of Mining Electrical and Mechanical Engineers is Mr. J. Sutton, a mechanical engineer on the North Staffordshire Area staff of the West Midlands Divisional Coal Board, who has been prominently associated with local methane drainage schemes. Mr. Sutton was elected on Monday to succeed Mr. S. Kelsall.

Mr. D. Cartledge, the secretary, reported that membership had been maintained around the 200 mark. Average attendance at meetings had shown a slight rise and the graduate and students' section was becoming more active. Fifteen candidates, compared with 12 last year, would sit the coming association examination.

The hon. secretary and Mr. J. W. Mould, hon. treasurer, were re-elected, and new vice-presidents elected were Mr. E. W. Watson and Mr. C. W. Hibbert. Mr. K. C. Ball, Mr. A. Green and Mr. E. Stubbs were appointed additional members of the committee.

Coal Campaign Widens

INDUSTRY'S "DETERMINATION TO FIGHT PREJUDICE"

CAMPAIGN to stimulate sales of solid fuel, inaugurated by Mr. Alfred Robens, chairman of the National Coal Board, in London last week, was extended across the country this week. Most challenging note was sounded by Mr. W. H. Sales, chairman of the North-Eastern Division of the NCB, who made it clear that the board was determined to fight any prejudice there might be against the industry. "We are not asking for special privileges for the coal industry," he said. "What we are determined to do, both on the production and the sales side, is to secure the willing co-operation of the public in the examination of ways and means by which coal and solid fuels can be used."

Mr. Sales was speaking at the opening in Sheffield on Monday of the first of several information, service and order centres to be set up by the North-Eastern Division. By the establishment of such centres, he said, the board hoped to bring to the minds of the public the fact that solid fuels provided the means for heating equal to and better than other available forms of energy.

MR. W. H. SALES

The alliance, over many years, between coal and steel made it fitting that the first centre should be in Sheffield, he went on. "Whichever way one looks at it, the coal industry is massive—massive in its machinery and massive in the community it forms. One cannot, in assessing the present or the future, treat flippantly an industry like the coal industry." The industry was determined to fight in order that the prosperity of those who worked in it was ensured, and the economy of the country benefited, he said.

New Productivity Record

Mr. Sales suggested that the real job of putting over the value of coal lay with the NCB itself. Emerging from a monopolistic position into a more competitive one, it was necessary for the board to see where it was vulnerable, and the answer was that coal could be vulnerable in convenience, in price, and because people were ignorant of the efficiency of solid fuel appliances. No one need be ignorant of these appliances, and the NCB wanted to enlist the aid of manufacturers and anybody else in production and technical aspects and in sales.

The centre, which was opened by the Lord Mayor of Sheffield, Ald. H. Slack, includes a showroom display of fires suitable for smokeless fuels and coal burning, and Mr. Sales said that similar centres would shortly be opened at Doncaster, Leeds, and Wakefield. Inaugurating the sales drive at a Press conference and reception at the division's Solid Fuels Exhibition at Grimethorpe on Friday, Mr. Sales said that sales of coal from the division in recent weeks had been running 50,000 tons a week ahead of last year. More than 1,300,000 tons of deep mined coal had already been lifted from stocks this year, compared with 1,500,000 tons last year when 3,500,000 tons more coal was sold than in 1959. Stocks in Yorkshire had now been cut to 2,700,000 tons of both deep mined and open-cast coal from a peak figure of 6,250,000 tons in September, 1959. Any general shortage of coal was highly unlikely, although some types might be hard to come by because of the heavy stock run-down.

Mr. H. Clarke, divisional marketing director, said that coupled with this encouraging outlook was news of plants to produce a new type of smokeless fuel which burned with a bright flame. A pilot plant was now producing this fuel, and while it was still having its teething troubles there were plans for a major plant from which it was hoped there would be reasonable quantities of fuel by early next year. By 1965 it was expected there would be a number of these plants in Yorkshire and the East Midlands Division.

Launching the East Midlands Division's part in the campaign at Nottingham on Monday, Mr. W. L. Miron, chairman, said the division was urgently looking into new and more modern ways of selling fuel. "We are trying to encourage, on the domestic market, sales of pre-packaged coal and smokeless fuel, and have established our own pre-packaging plant in Nottingham."

Mr. Miron said it was intended to initiate a system of hire purchase for coal in the near future, not only because it was a convenience factor to the householder to have his fuel problems taken care of, but also because it resulted in a more efficient use of transport and the productive capacity of the industry throughout the year. "I offer this coalfield to the public as a supplier on whom they can rely, both as to quantity quality, and price. We are determined to give the consumer, large or small, full value for his money so far as the quality of our product is concerned."

Mr. Miron said that in the first three months of 1961 the division had achieved a record level of productive efficiency. This had been rising consistently since nationalization, and the present level was almost 50 per cent. higher than in 1946, the year before the Coal Board took over. Saleable output of coal during the first three months of the year was 11,499,000 tons —25 per cent. of the entire national deep mined tonnage.

Holding his first Press conference since he succeeded Col. G. G. H. Bolton as chairman of the North-Western Division, Mr. J. Anderton said in Manchester

on Tuesday that the industry's future in the north-west lay not only in more efficient ways of getting coal—at lower cost—but in the changing pattern of demand, particularly the spread of central heating. North-west people were regarded as the traditional supporters of the open fire, but they were now showing great interest in central heating and modern solid-fuel appliances. Since the board's housewarming plan was launched a year ago, more than 10,500 inquiries had been received and a total of £100,000 loaned to people who wished to install new appliances.

Mr. Anderton said that continuous, remote-controlled mining was probably no more than five years away now. This year it was hoped to increase the proportion of power-loaded coal in the division from 42 per cent. to 52 per cent.

Initiating the campaign by the West Midlands Division in Birmingham on Wednesday, Mr. H. A. Longden, chairman, said the division would play its full part in the "massive attack" to increase coal sales. The industry, he said, was not one which the nation could afford to see sacrificed by misrepresentation or misunderstanding, or see depressed or dissipated. "The National Coal Board has no intention of seeing this great industry sacrificed for any reason. Nor has it any intention of standing by and conceding markets that are necessary to enable the industry to operate economically and efficiently. The scale of our campaign is in line with the size and importance of the industry."

EYE-CATCHER at the Solid Fuels Exhibition at Grimethorpe was a lump of coal. Not even titivated up with a red-ribbon sash could its corpulence be disguised. Vital statistics of the Grimethorpe Giant were 9 ft. 9 in., 5 ft. 11 in. and 3 ft. 4 in. and it weighed a mere 6 tons 4 cwt.!

When Mr. James Dolan, group manager at Grimethorpe and Ferrymoor, was told that "a piece of coal" was wanted for the exhibition he had some cut from the 1,440-ft.-deep Beamshaw Seam at Grimethorpe. Under the supervision of Mr. G. H. Lockwood, manager of Grimethorpe, the lump was mounted on a sledge and winched over the 200 yards to the shaft side. Then came the task of raising it to the surface. It was found to be just a fit for the main riding deck of the skip. At the surface it was lifted by crane on the back of a lorry and taken to the exhibition hall.

Another Shaft-sinking Record at Kellingley

FURTHER all-time British record for shaft-sinking has been set up at the new Kellingley Colliery in the No. 8 (Castleford) Area of the North-Eastern Division of the National Coal Board, where 910¾ ft. of completed shaft-sinking was achieved during the first three months of this year. This was 85¾ ft. better than the previous best record in this country, established at Parkside Colliery in the North-Western Division.

Kellingley Colliery is the first new major colliery to be planned in the North-Eastern Division and when in full production—in 1964—will yield 6,000 tons of saleable coal a day.

Tunnelling Begins at Parkside Colliery

WORK has begun on the driving of 10 miles of tunnels to open up the coal faces at the new Parkside Colliery, Newton-le-Willows (Lancs), which will start production towards the end of next year. This phase in the construction of the £13,000,000 colliery follows the completion of the underground connections between the two shafts, each nearly 900 yds. deep and 24 ft. in diameter. The tunnelling teams will drive outwards from the shafts, under south-west Lancashire, and make 40 junctions before their job is completed.

On the surface the winding gear has been installed on the No. 1 winding tower, which is 191 ft. high and will be used to wind men and materials. The 204-ft.-high No. 2 shaft is being equipped for skip winding, using two 15-ton skips to bring the coal to the surface. The administrative block, which includes the pithead baths, canteen, and medical centre, is nearly finished and the pit's "nerve centre"—a combined compressor, fan house and electricity sub-station—will be completed shortly. The fan, which has been installed, is one of the largest in Europe and is capable of circulating 870,000 cu. ft. of air a minute through the colliery. The pit's workshops have been built and at present work is proceeding on the building of a coal preparation plant which will be able to deal with 450 tons an hour.

Boring for coal deposits started at Newton in 1950 and the borings proved the existence of about 100,000,000 tons of high-quality coal in six seams. The foundation stone was laid in May, 1957, and afterwards the two shafts were sunk in record time. Parkside will ultimately employ 2,000 men and will produce about 1,000,000 tons of coal a year. It will be an all-electric highly mechanized colliery where the latest machines will replace picks and shovels. Controlled tipping will mean that there will be no slag heaps.

NCB Civil Defence Post for Mr. A. C. Beaton

AT present assistant Area general manager of the North Staffordshire Area of the West Midlands Divisional Coal Board, Mr. A. C. Beaton has been appointed Civil Defence organizer at the National Coal Board headquarters, Hobart House, London, W.1. Mr. Beaton was appointed to his present post in December, 1955.

After taking first class honours at Oxford, of which he is an MA, he joined the Sudan political service in 1927. A series of administrative posts followed which led to his becoming, in 1954, Permanent Under Secretary to the newly-created Ministry of the Interior of the Sudan Government. In this post he was responsible for the administration of the whole of the Sudan.

During the war Mr. Beaton raised, and for a time commanded, a body of troops which operated on the Eritrean front. For his Government service, he was made a CMG in 1954.

PRIOR STOKERS, LIMITED—Mr. A. E. A. Wright is to resign from the board at the end of the month.

More Steel for Europe

ECSC ESTIMATE FOR CURRENT QUARTER

DURING the second quarter of this year, about 18,700,000 metric tons of raw steel will be produced in the six countries of the European Coal and Steel Community, according to estimates prepared by the ECSC High Authority. Stocks held by the steel-processing industries and the trade are expected to rise slightly above the corresponding quarter of 1960. The falling-off in car exports is likely to have an effect on the sheet steel market but no major influence on steel consumption is expected to result from the revaluation of the Deutschmark and the Dutch florin.

The estimated figure for steel output for the current quarter compares with 18,550,000 tons in the previous quarter and 17,860,000 tons in the second quarter of last year. While West German production is expected to fall from 8,760,000 tons in the first quarter of this year to 8,400,000 tons in the current quarter, French output is expected to stay at the first quarter's level of 4,600,000 tons, and that of the other four ECSC countries will increase slightly over the three-month period.

The High Authority fixes likely steel exports during the current quarter at 3,300,000 tons and imports at 700,000 tons.

Grant for Italian State Steel

Under an agreement signed in Rome between the European Investment Bank, and the Italian Government and the Southern Fund, the Bank is to grant the Italian state steel group, Finsider, credit amounting to 15,000,000,000 lire. The credit will be used for the building by Finsider at Tarento of a steelworks and tube factory costing a total of 236,000,000,000 lire. The Tarento plant, the fourth large-scale steelworks of the Finsider group, will produce 2,000,000 tons of raw steel and 200,000 tons of welded tubes and pipes a year.

The Ilva steelworks, which is largely state-owned, has announced an unchanged dividend of 7 per cent. for 1960, despite an increase in steel production of 18 per cent. to 1,700,000 tons and in pig-iron of 32 per cent. Ilva now produces 58 per cent. of all pig-iron manufactured in Italy. Rolled steel production from Ilva's eight mills rose last year from 1,050,000 tons to 1,230,000 tons. With the aid of new investment, Ilva increased capacities by the start of this year to 950,000 tons of pig-iron and 930,000 tons of raw steel at the Bagnoli plant, and to 720,000 tons of pig-iron and 700,000 tons of raw steel at the Piombino works. The tube plant, which forms part of the new Tarento steelworks, is to be brought into production this year and a new rolling mill at Novi Ligure next year.

By 1965, capacities planned are 1,650,000 tons of raw steel, and 1,500,000 tons of pig-iron at Bagnoli, 1,530,000 tons of raw steel and 1,160,000 tons of pig-iron at Piombino, 500,000 tons of pig-iron at Trieste and 2,000,000 tons of raw steel at Tarento. For the operation of the Tarento plant and for other operations in general, a fusion is planned between Ilva and the Cornigliano concern under the name of Italsider.

Cornigliano, in which the Government is also the major shareholder, has also announced an unchanged dividend of 7 per cent. for 1960. Its raw steel output rose last year by 34 per cent. to 1,350,000 tons, while that of steel products went up from 892,000 tons to 1,260,000 tons. About 179,000 tons of steel products were exported. The company is concentrating expansion on its "Oscar Sinigaglia" plant, where raw steel capacity is to be brought up to 2,000,000 tons. By 1964 the company plans to be producing 2,000,000 tons of raw steel and 1,550,000 tons of pig-iron a year—about double the present levels. Ilva is planning to raise its capital to 72,600,000,000 lire, and Cornigliano its capital to 70,000,000,000 lire.

According to the Steel Industry Federation of France, French steel production in March reached an all-time record of 1,643,000 tons, compared with 1,469,000 tons in February, and 1,515,000 tons in March, 1960.

FBI President on Ways to Increase Exports

FIVE-POINT plan to increase exports was put forward by Sir William McFadzean, retiring president of the Federation of British Industries, at the federation's annual meeting in London on Wednesday. He said that the UK must aim at a rise of at least 10 per cent. in exports during 1961, and the first of his points was that more attention must be given to the tastes and requirements of oversea customers, and a better delivery service.

Sir William urged those concerned to "put their house in order" and render the most competitive and effective assistance to the cost of British exports, and the third phase of his plan concerned salesmen. There were not enough salesmen on the road, in the first place. Salesmen should be able to speak languages, know the feelings and appreciate the requirements and aspirations of the countries to which they were selling, and should be given maximum status.

Sir William also dealt with salesmanship and asked: "How effectively do we tell the world about outstanding British firsts in the scientific and industrial spheres, and of how modern and efficient most of our industry is?" Finally, he called for flexible and speedy implementation in credit and credit insurance regulations. "I feel there should be a more simplified method of obtaining finance where credit can be given."

Mr. E. A. ATKIN, formerly assistant chief engineer, has been appointed deputy chief engineer of Appleby-Frodingham Steel Company, branch of the United Steel Companies, Limited.

Appointments

British Jeffrey-Diamond Technical Manager

NEW district technical manager for British Jeffrey-Diamond, Limited, mining machinery, air turbine manufacturers, etc., of Wakefield (Yorks), is Mr. GORDON C. MATTHEWS.

MR. G. C. MATTHEWS

Mr. Matthews, who was formerly assistant district technical manager in Scotland to the late Mr. Andrew Hall, graduated with honours in mining engineering from Glasgow University in 1954. He holds a colliery manager's certificate, and is an associate member of the Institution of Mining Engineers, and a member of the Scottish Branch of the National Association of Colliery Managers.

Mr. DENNIS C. HARDAKER has been appointed secretary of the Bright Screw Company, Limited.

Metal window manufacturers of Chester, Williams & Williams, Limited, has appointed Mr. J. C. CORBY to the newly-created post of general manager.

Appointed manager of the new diamond-drilling division of Coventry Compressors, Limited, plant hirers, of London, S.W.8, Mr. T. A. JENKINS has resigned his position as technical manager of Holemasters, Limited.

Mr. E. L. MORGAN, formerly works metallurgist, has been appointed chief metallurgist of Workington Iron & Steel Company, branch of the United Steel Companies Limited. Mr. A. G. HOCK, formerly research manager, has been appointed metallurgical consultant at Workington.

Mr. NORMAN FOX has been appointed export manager of W. & T. Avery, Limited, weighing, counting, and testing machine makers, of Birmingham. He joined the company in 1935 and has served in the oversea department. Mr. S. A. Martindale, oversea sales manager, has retired after 26 years' service with the firm.

The Council of the Institute of Metals has appointed Mr. R. E. MOORE to succeed, as secretary, Lt.-Col. S. C. Guillan, who retires on April 30. Mr. Moore has been assistant secretary of the institute since 1947. Before joining the institute he was assistant to the Registrar of the then recently formed Institution of Metallurgists.

Mr. W. R. OWEN has been given responsibility for the Cardiff and Manchester branches of Honeywell Controls, Limited, in addition to continuing as Birmingham branch manager. Mr. T. JACKSON has been appointed field sales manager for heating, ventilating and air conditioning controls in commercial buildings and Mr. R. ROBSON market sales manager for the metal processing industries. There are two other new market sales managers: Mr. E. R. AMERY for the chemical industry, and Mr. H. WIGMAN for the food and fibre industries.

Management and Staff Changes at Newton Chambers

AS a result of management and staff changes in the engineering division of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield, Mr. K. Sheard, contracts manager, becomes responsible for the co-ordination of the purchasing and drawing office department in addition to his present responsibility for contracts and inspection. Mr. Sheard is a director of the subsidiary, George Royston & Son, Limited, Barnsley. Mr. W. A. Leaver, who first joined the company in 1934, and has been successively chief of engineering and chief design engineer, becomes chief engineer.

Mr. J. H. Womersley, senior contracts engineer since 1957, is appointed deputy contracts manager. He started with the company as an apprentice draughtsman in 1940 and has been contracts engineer for the gas and chemical plant section and deputy to the contracts manager. Mr. D. B. Armitage, design engineer for chemical plant and deputy to the chief of engineering since 1955, becomes chief design engineer, and Mr. G. Baines, contracts engineer, becomes senior contracts engineer.

In the excavator division of Newton Chambers, Mr. E. Wilke, assistant accountant, has been appointed assistant divisional accountant. Mr. E. Dyson becomes chief draughtsman, Mr. F. Dickinson, designs engineer (development), Mr. I. Emson, designs engineer, and Mr. R. A. Harrison, assistant field service manager.

New Area General Manager for South-Western NCB

GENERAL MANAGER of the No. 5 (Eastwood) Area of the East Midlands Divisional Coal Board since 1957, Mr. T. Wright has been appointed general manager of No. 4 (Aberdare) Area of the South-Western Division of the NCB. Mr. Wright started work at 14 as a screen hand at Moorgreen Colliery (Notts), and won a mining scholarship to Nottingham University College, gaining his mining diploma in 1937.

After leaving college he served as deputy and overman at Bentley Colliery (Yorks), and later held the position of manager at Church Gresley Colliery and then of Woodside Colliery in Derbyshire. He was appointed production manager in No. 4 Area of the East Midlands Division in 1954.

NEW JOINT COMPANY TO EXPORT FORDATH PRODUCTS

FORMATION of a joint company to be known as Foseco-Fordath, Limited, has been announced by Foseco International, Limited, and the Fordath Engineering Company, Limited. It will mean that the core binder products of the Fordath Company will now be available in all markets of the world through the extensive sales organization of the Foseco group with its 16 manufacturing and sales units and 43 distributors covering 51 countries.

Within the UK products from its plant in West Bromwich (Staffs), will continue to be marketed exclusively by Fordath. The marketing of specialized foundry equipment, it is stated, is not included in the agreement.

Orders Placed

SIMON-CARVES' £7,000,000 ORDER

For Four "Iron Curtain" Countries

CONTRACTS worth £7,000,000 for the design of four polythene plants for "Iron Curtain" countries were signed on Tuesday by Simon-Carves, Limited, a member of the Simon Engineering, Limited, group. The plants—for Czechoslovakia, East Germany, Poland, and Rumania—will be built during the next three years and Simon-Carves engineers will assist in their erection and will remain on hand to see them put on stream. The technical "know-how" is being supplied to the four by Imperial Chemical Industries, Limited, for a sum which has not been disclosed.

All the specialized equipment covered by the contracts will be manufactured in Britain. Further detailed arrangements for the supply of such equipment are to be negotiated immediately with the four countries concerned.

A spokesman for Simon-Carves said on Tuesday that the placing of the orders in the UK represented "a considerable achievement for all the parties concerned, particularly in view of the language complications and the varying technical, legal, and statutory requirements of each country."

Simon-Carves designed and constructed the polythene plants now being built in Mexico and Yugoslavia and was responsible for the first polythene plant to go into operation in India.

Asquith Breaks into Japanese Market

ORDERS worth together £150,000 which the Asquith Machine Tool Corporation, Limited, has secured from Japan are regarded by the company as an important step towards breaking into the Japanese market where Germany is very active.

The 6-in. ram-type horizontal boring and milling machine, worth £100,000, which has been ordered for Japan's heavy electrical industry, will be the largest machine tool sent from this country to Japan since the war. The machine will be built at Asquith's Halifax works and will be delivered in September. The company has also won contracts for radio drills and gear-cutting machines worth about £50,000.

ORDER for over six miles of 33,000V flat oil-filled pressure cable, solid type cable and associated auxiliary cables has been awarded to Enfield-Standard Power Cables, Limited, by the Eastern Electricity Board. The contract is worth £150,000.

AN ORDER worth £2,300,000 has been given to the Associated Electrical Industries, Limited, by the Central Electricity Generating Board, for a third 300 mW turbine-generator for the board's West Thurrock power station. AEI contracts for West Thurrock now total over £7,000,000.

IN ADDITION TO the push rods it already supplies to Ford Motor Company, Limited, Dagenham (Essex), and many other companies, the screw division of Guest, Keen & Nettlefolds (Midlands) Limited, has secured an order for a large quantity of push rods from Ford-Werke, Cologne, for current production.

AN ORDER has been received by W. H. Allen & Company, Limited, from the Thames Board Mills, Limited, Purfleet (Essex), for a 10.5 mW pass out back pressure turbo-alternator set for installation in its power station. The plant is to supply power and process steam for the firm's expansion programme.

FOLLOWING "on the spot" negotiations by its general sales manager, Mr. J. F. D. Wood, Sanders & Forster, Limited, Barking (Essex), a member of the Chamberlain group of companies, has secured an order for supplying the structural steelwork for a 75,600 sq. ft. extension to an Ethiopian cotton textile mill.

ORDER HAS BEEN placed by the North-Western Division of the National Coal Board with Heyes & Company, Limited, Wigan, for two type 3436 locomotive haulage signalling systems for installation at Agecroft Colliery, nr. Manchester. Designed for train control underground, the system utilizes red, amber and green aspect signals on the "traffic-light" principle.

CABLES AND ACCESSORIES for the paper and pulp mill of the Tasman Pulp & Paper Company, Limited, Kawerau, New Zealand, are to be supplied by British Insulated Callender's Cables, Limited. The materials to be supplied include the electrical installation requirements of the second paper machine now being installed, and cover 11 kV and low-tension paper insulated mass-impregnated non-draining type cables; 3.3 kV butyl insulated cables, and PVC sheathed mineral insulated cables, etc.

CONTRACTS worth about £670,000 for the supply of steel pipe for Canada's natural gas project have been awarded to Stewarts and Lloyds, Limited, through its Canadian subsidiary, Stewarts and Lloyds of Canada, Limited. More than 100 miles of pipe is to be supplied to convey "sour" natural gas from the gas fields of Alberta to cleaning plant now being built. This will include 26 miles of 14 in. diameter pipe of ½ in. wall thickness. The contracts were signed with Hudson's Bay Oil & Gas Company, Limited, and Shell Oil Company of Canada, Limited.

BOILER ORDER worth about £2,250,000 has been awarded to Mitchell Engineering, Limited, through its associate, Mitchell Engineering Proprietary, Limited, Johannesburg, by the Electricity Supply Commission of South Africa. The order includes the supply and erection of two boilers for Komati power station in the Eastern Transvaal, which will be the largest in the Union and are due to be commissioned in 1964. Arrangements are being made for some 80 per cent. of the plant to be made in South Africa. Mitchell has already installed two 100 mM boilers at the station.

Personal Contact Key to Export Success

SPEAKING from the chair at the northern conference of the British Institute of Management at Southport (Lancs), last Friday, Mr. John Oldham, chairman and joint managing director of Oldham & Son, Limited, battery manufacturers, etc., of Denton (Lancs), described how in the 15 years since the war, he built up an export trade with world-wide markets and oversea manufacturing plants and did it without prior export experience.

MR. JOHN OLDHAM

"I am often asked," he said, "whether, by the same methods, other companies could enter such markets today. My answer is 'yes, it can be done.' Conditions have, of course, become more competitive, but the markets and the opportunities are still there for those who have the right products and, just as essential, the right outlook and attitude of mind." Mr. Oldham stressed one of his golden rules, the importance of personal contact, not only by top executives, but right through the company structure to foreman level.

"I spend 25 per cent. of my time overseas each year, visiting the company's subsidiaries and overseas markets, and I find it to be a very pleasurable, stimulating, and enlightening activity. No written contact equals the personal contact," he said. One of Mr. Oldham's priority rules is that all letters from oversea staff should be answered within 48 hours.

Speaking of what he describes as "the Oldham Commonwealth," Mr. Oldham said, "in Britain is the technical fountainhead, able to experiment with the latest techniques in management and production, but the parent company needs its oversea units just as much as they need her. They enable us to tackle markets which are closed to us in the UK. They have technical ideas to teach us. Perhaps more important than anything else, such group-thinking jogs one out of any parochial considerations, and is a stimulus to thought and endeavour."

Mr. Oldham went on: "Important though it is, the national need for export is only one aspect of the story. My recommendation is to consider most thoroughly and carefully what an entry into new export markets—or an intensified drive into markets you already have—would mean to you, both personally and as a company. I am sure that—like myself—you will never regret it."

Portugal's New Steel Plant Opening Within a Month

BLAST FURNACE at Portugal's new steel plant at Seixall, a few miles south of the Tagus from Lisbon, is expected to be in operation within a month's time. During its first phase Siderugica Nacional aims at producing 200,000 tons of rolled steel a year. Its target is 500,000 tons yearly by 1964.

Last year Portugal imported 325,000 tons of steel, 20,000 tons more than in 1959.

Forth Bridge Wire Cables in Last Stage of Manufacture

DRAWING of 7,500 tons of wire which will be used in the suspension cables of the new Forth road bridge has reached its final stages of manufacture at the Middlesbrough works of Dorman Long (Steel), Limited. The special high-tensile steel wire, over 11,000 strands of which will go into the main cable nearly 2 ft. in diameter, has been made in the UK for the first time, and called for the installation of special equipment both at the wire works and on the bridge site.

The wire, 30,000 miles of it, has been drawn from special high carbon steel rods produced at Dorman Long's Lackenby mill, and during its manufacture the coils of finished material have been protected from deterioration and corrosion by being covered with sealed polythene sheets in special storage facilities. Mr. E. T. Judge, managing director of Dorman Long (Steel), said last week that the company had recently spent £800,000 on new developments at the wire works, and as a result capacity has been more than doubled.

The cables will not be twisted but the wires in each will be laid continuously in parallel into 37 strands, each of 314 wires, held together by metal bands. When all 37 strands are laid together in each cable the 11,618 wires in them will be compacted, under hydraulic pressure, to a diameter of only 23.25 in. Then they will be wrapped in 0.418 galvanized steel wire before being waterproofed.

The two cables will have a breaking load in excess of 70,000 tons—more than adequate for the safety factor laid down.

The wire is being delivered at the site in half-ton coils, which will be spliced together to make a continuous length reeled out for spidermen to lay, in an operation which is expected to last for about three months.

This method of creating powerful cables from wire in parallel is not new, although it has never been used in this country. It was first used in the construction of the Brooklyn Bridge in New York in the 1880s, and Dorman Long had experience of it in a bridge built in Rhodesia before the war. The only reason it has not been used in Britain before is that no suspension bridges big enough to warrant it have been built in this country until now.

Preheating, pickling, washing, cold drawing, and galvanizing are all carried out in a continuous process. Exacting specifications and rigid inspection require a complete quality control system from blast furnace to galvanizing. At the end of the line there is a specially-built testing house in which independent examiners work 24 hours a day testing every coil of wire.

Cranes for South Africa Delivered on Time

IN view of recent adverse comment about delivery promises given by British manufacturers, the chairman, Mr. J. B. Woodeson, at the annual meeting of Clyde Crane & Booth, Limited, said he was proud to announce that the company's contract for 32 dock cranes for South Africa was delivered right up to time. Tenders have been lodged for a further batch of similar cranes.

Mr. Woodeson announced that the company had also secured a substantial export order for India. The present order-book is substantial, covering the whole of 1961, a considerable part of 1962, and a number of jobs which extend into 1963.

CONTROL OF MINE VENTILATION

PART 1: RESISTANCE OPPOSING THE FLOW OF AIR

*by G. A. Percival, B.Sc.**

In this paper, presented to the Midland Branch of the National Association of Colliery Managers on November 28, 1960, consideration is given to the resistance opposing ventilation and the method of formulating the details of a resistance survey. The effects of changes in the resistance of a mine are discussed, together with advantages and limitations of splitting. The need for ventilation planning to assess future requirements, the necessity for controlling the system resistance, the use of booster fans, and the effects of rapidly advancing faces on gas emission are considered in the second part of the paper, which will appear in our next issue.

FROM investigations made into the possible causes of colliery explosions, there is justification for concluding that in most of these unfortunate occurrences a contributory factor was that of not having adequate ventilation in part or parts of the mine.

The recent report compiled by the Coal Industry National Consultative Council, Safety and Health Sub-committee on Mining Explosions substantiates this view by saying: "Of the practical mining requirements for protection against the possibility of underground explosions, the need for good ventilation is undoubtedly the most important." In this report also, in the first of the general considerations on ventilation, it states that "A prerequisite to sound ventilation is a carefully planned method of working a mine or seam in which due regard has been paid to the problem of ventilating the workings." Furthermore, it adds: "Whatever the particular problems presented by individual collieries may be, the important general requirement is that there should be a plan, and that the colliery ventilation system should not be merely the result of expedients progressively adopted as the workings advance."

The Law of Flow of Air Through Mine Roadways

In the study of mine ventilation, it is essential to realize, to the fullest extent, the law of flow of air in mine roadways and systems. Throughout the history of coal mining until 1938, the analytical study of the flow of air in mine airways was based on the Atkinson formula $P = \frac{KSV^2}{A}$ or $P = \frac{KSQ^2}{A^3}$, a law which was based on the results of research work on the flow of fluids through pipes. The late J. J. Atkinson, in his research on the characteristics of the flow of air in mine circuits, realized and resolved the various components involved, but many students and candidates for manager's certificates, and, indeed, managers of collieries at that time, met some difficulty in the practical application of the flow law presented by this formula.

Resulting from further research on the subject, the original formula has now been simplified by grouping together the physical components, $\frac{KS}{A}$ and substituting the term "resistance." Thus, a unit of resistance, which is now familiarly known as the "Atkinson," has been defined.

The present formula, known as the modified Atkinson formula may be stated as $P = RQ^2$; this has now become the basis of all ventilation calculations, and is of the utmost use in planning the future ventilation of mine circuits and in assessing resistances.

In this paper the terms involved in the modified formula are reviewed, and an endeavour is made to assist mining men to appreciate their practical value, and to enable them to attain a position from which they may forecast the practical work required in the mine from time to time to ensure satisfactory and adequate ventilation in all parts of the mine, both in the immediate and distant future.

The Modified Formula

The Atkinson formula consists of three terms only: pressure, resistance, and quantity. The expression $P = RQ^2$ is simply a symbolic method of expressing how any two components in the formula are affected

* Ventilation engineer, No. 4 Area, East Midlands Divisional Coal Board.

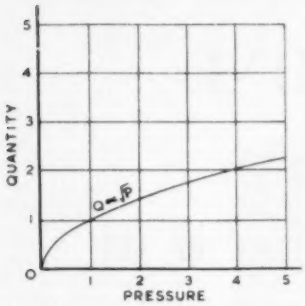

FIG. 1.—GRAPH OF THE RELATIONSHIP BETWEEN QUANTITY AND PRESSURE WITH CONSTANT RESISTANCE.

by a change in the third, and by its constitution, is termed a square law. Thus, the quantity of air which will flow in a system will vary in accordance with the square root of the pressure applied (or induced) if the resistance is constant.

Therefore, with constant resistance, $Q \propto \sqrt{P}$, or as an example, if the pressure on a system is changed from 4 units to 9 units, Q changes in the proportion of $\sqrt{4}$ to $\sqrt{9}$, or in the proportion of 2 : 3, which is a 50 per cent. increase. Also, if the pressure applied to a system is constant, then the quantity flowing in the system will vary inversely as the square root of the resistance, thus $Q \propto \frac{1}{\sqrt{R}}$ *i.e.*, if the resistance of a system increases from 4 units to 5 units then Q will decrease in the proportion of $\frac{1}{\sqrt{4}} : \frac{1}{\sqrt{5}}$, or as $\frac{1}{2} : \frac{1}{2.236}$ or by 10.5 per cent. The quantity flowing in any system, therefore, depends principally on two things (*a*) the ventilating pressure, whether it be induced by a suction fan or applied in the case of a forcing fan, and (*b*) on the resistance of the system itself.

The graphs of quantity varying as $\sqrt{P}$ with constant resistance, and quantity varying as $\frac{1}{\sqrt{R}}$, with constant pressure, are illustrated in Figs. 1 and 2.

Determination of Quantity

In reviewing the components in the modified formula, the quantity term is appreciated to a higher degree than the remaining two, because it is the one that is actually measured and recorded to enable an assessment to be made of the ventilation conditions.

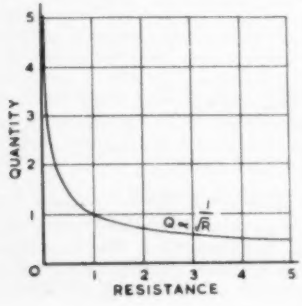

FIG. 2.—GRAPH OF THE VARIATION OF QUANTITY WITH RESISTANCE AT CONSTANT PRESSURE.

The flow or quantity passing in a mine roadway or a system is determined from measurements of air velocity by the use of the anemometer, and of the sectional area of the roadway or duct at the point of measurement. The sources in which error may be introduced in the evaluation of quantity are many and, in view of the numerous papers recently written on this subject, reference to it here is only brief. The conclusions drawn from these investigations, however, clearly indicate the importance to be given to the choice of the measuring station, the use of the anemometer, the calibration factor, and the measurement of the sectional dimensions of the road.

In all cases when a measurement is made, a check should be made at another point in the airway, or, if the point is in an intake, at an appropriate point in the return, or *vice versa*. The units invariably used for measuring and recording purposes, and in practical work are in cubic feet per minute, as distinct from those to be applied in the use of the formula $P = RQ^2$ in the evaluation of resistance and pressure when the quantity term must be expressed in units of 1000s of cu. ft./sec.

Pressure Component in Ventilation

The pressure component in ventilation is established by the surface fan, which, in turn, depends on its diameter, width, speed of rotation, and on the resistance of the system on which it operates. It is measured by the water gauge or manometer, an instrument which, by law, must be installed in the fanhouse. The reading must be observed every 30 min. unless an exemption is granted for an extension of this interval by the Inspectorate. As is well known, the units are indicated in inches of water gauge, but these can be converted into pounds per square foot by multiplying by the factor of 5.2. Pressure is more keenly realized when stated as a force on unit area (as pounds per square foot), and there is the possibility that the whole aspect of pressure would be more appreciated in the study of mine ventilation if the units could be indicated and recorded in such terms.

The pressure recorded in the fanhouse will not be the same as that measured between the shafts at surface level on account of an increment of pressure which is dissipated in the fandrift. Furthermore, that pressure measured between the shafts at surface level may differ from that measured through separation doors in a connecting road in the pit bottom, due to the effect of the natural ventilation created by temperature difference of the air in the two shafts. If the reading is the same, then the pressure drop or the pressure dissipated in passing the air through the shafts is equivalent to the natural ventilation effect.

In shallow shafts of small cross-sectional area, the effect of natural ventilation may be very small and in most cases the pit-bottom water gauge is less than that at the surface. In the case of large deep shafts, the pit-bottom water gauge may be in excess of the surface water gauge by several inches and, in this case, assists the ventilation appreciably. The value

of natural ventilation and shaft resistance may easily be assessed if there are intermediate landings and connecting roads from downcast to upcast shafts in which separation doors are installed and through which the water gauge can be measured.

Pressure Surveys

In the same way that the full ventilating pressure on a system or the total pressure dissipation is measured by the water gauge in the fanhouse, so small increments of the pressure dissipated between any two points within the system itself can be measured by a modified instrument such as an inclined gauge or micro-manometer. With this instrument, a complete continuous pressure survey can be made throughout the system, and as " P " is the surface water gauge inducing the total quantity through the system, " p " or an individual increment is the pressure required to induce a particular flow of air between two points within the system.

Because of the effect of natural ventilation in the shafts, it is usual to commence such a survey from the downcast shaft bottom and proceed through the circuit in the same direction as the air flow, finishing at the upcast shaft. The sum of the individual increments of pressure should be equal to the prevailing pit-bottom water gauge if the workings are level. In steep workings errors may be introduced into the individual figures obtained within the circuit owing to the natural ventilation effect. A good assessment of the way in which the available pressure is dissipated or an approximate pressure survey may be made by taking readings of water gauge through separation doors in connecting roads between intake and return starting in the pit bottom and working inbye (Fig. 3).

Resistance

In the same way that the total resistance of the system can be calculated from determinations of the water gauge and the flow at the fan, the resistance of a section of road between any two points can be calculated from the pressure drop or the water gauge operating between the points and the quantity flowing. In the evaluation it is important that the proper units be applied. The pressure units should be in pounds per square foot and the quantity units in 1,000s of cubic feet of air flowing per second.

With the use of these units the resistance is obtained in Atkinsons. The Atkinson may be defined, therefore, as the resistance of a section of roadway in which there is a pressure drop of 1 lb./sq. ft. throughout the section, when the quantity of air flowing is 1,000 cu. ft./sec. (1 kilocusec).

The resistance component " R " in the law of flow ($P = RQ^2$) is the only one which can be controlled in a practical way by the execution of physical work in enlarging and maintaining the roadways to a certain resistance value, or conforming to a system of making duplicate airways, or to the judicious planning of main splits.

The pressure component, however, which is established by the fan can only be varied by a speed change at the fan, and even then the pressure which is created, and the quantity flowing at the fan depends on the resistance of the system, as will be explained later.

In the complete analysis of the law it may be proved that for a unit length of airway, its resistance varies inversely as the cross-sectional area to the power of $\frac{5}{2}$, or mathematically stated $R \propto \frac{1}{A^{5/2}}$ or $R \propto \frac{1}{\sqrt{A^5}}$. As a practical example, this means that if a section of main intake airway 1,000 yd. long has a resistance of 16 Atkinsons, then if this section of road is allowed to deteriorate to half its original cross-sectional area, the resistance is increased in the proportion of $1 : \sqrt{2^5}$, or as $1 : \sqrt{32}$, or by 5.66 times the original figure to a value of 90.56 Atkinsons.

Considerable reduction in resistance can, therefore be obtained by enlarging roadways, particularly the trunk airways which carry large volumes of air. From a pressure/quantity survey made throughout a system, the resistance of individual sections can thus be calculated, and summated to produce a full resistance survey of the mine.

In its compilation the effect of any parallelism of sectional resistances must be taken into account and the combined resistances calculated from the law of parallel circuits, *i.e.* $\frac{1}{\sqrt{Rc}} = \frac{1}{\sqrt{R_1}} + \frac{1}{\sqrt{R_2}} + \text{etc}$.

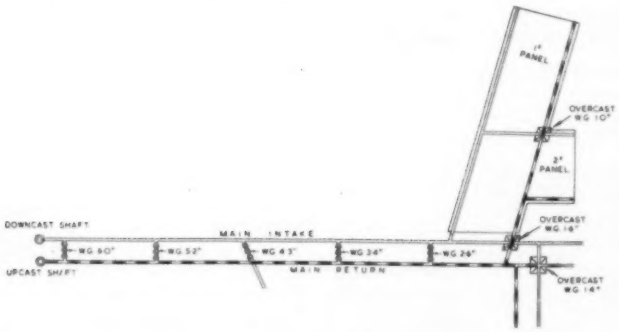

FIG. 3.—SURVEY OF DISSIPATION OF PRESSURE THROUGH SEPARATION DOORS, CONNECTING INTAKE, AND RETURN ROADWAYS.

The resistance of major parts of the system can be checked from the prevailing water gauge and the quantity flowing into these parts. Such resistance plans are illustrated in Figs. 4, 5, and 6.

Fig. 4 shows the results of a pressure/quantity survey from which the resistances of the sections are calculated. Fig. 5 shows a general diagrammatic layout of the system indicating the major splitting points, the major splits, and their respective resistances, and Fig. 6 shows the analysis of the resistances within the major working splits.

From Fig. 5 it will be seen that the system is a complicated one, the present productive workings com-

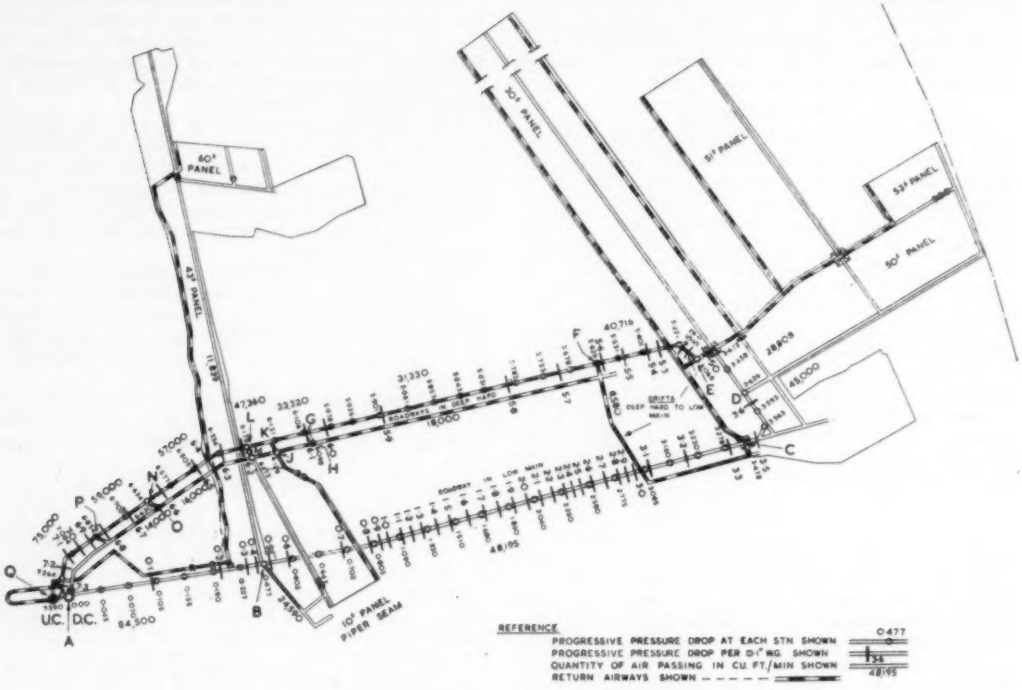

FIG. 4.—TYPICAL RESULTS OF A PRESSURE/QUANTITY SURVEY.

prising three main splits (1), (2), and (3). Splits (1) and (2) (*i.e.*, 30s Low Main inbye area and 10s Piper workings) are in parallel from the points B to K, and split (3) (or 43s district in the Low Main Seam) is in parallel with the combined resistance of splits (1) and (2) plus that of K to Q.

The respective resistances are calculated as follows from the operating pressures and the quantities flowing in them:—

Split No. 1: (LM 30s) (Inbye of B–K) Q = 48,195 cu. ft./min P = 5.654 in. w.g. R = 45.56 Atks.	Rc (1) and (2) in parallel . . (+2.90+1.78 for main return outbye K)	= 20.00 Atks.	
Split No. 2: (Piper 10s) (Inbye of B–K) Q = 24,590 cu. ft./min. P = 5.654 in. w.g. R = 175.0 Atks.		= 4.68 ,,	
		24.68 ,,	
Split No. 3: (LM 43s) (Inbye of B–Q) Q = 11,839 cu. ft./min P = 6.913 in. w.g. R = 923.31 Atks.		923.31 Atks.	Rc = 18.23 Atks. (On B–Q)
Add for section of main intake (A – B) in series (In the evaluation of the total main split resistance the resistance of the intake outbye point B and that in the return outbye K must be taken into account.)			1.24 Atks.
Main split resistance from shafts		Total . .	19.47 ,, (On A–Q)

This total of resistance 19.47 Atkinsons may be checked by calculation from the total flow into this part of the mine and the water-gauge operating, *i.e.*, 84,500 cu. ft./min. at 7.39 in. w.g. = 19.40 Atkinsons.

Any further splits in parallel such as leakage in the pit bottom (12,000 cu. ft./min.), Old Piper workings being drawn off (25,000 cu. ft./min.), pump house (8,500 cu. ft./min.), surface leakage (40,000 cu. ft./min.), indicated on the plan may be assumed as

TABLE 1.—*Comparison of Results of Combined Resistance with the Overall Resistance.*

Resistance as calculated from fan output.		Resistance calculated from all splits in parallel.	
	—	PRODUCTIVE WORKINGS SPLITS 1, 2, and 3. 84,500 cu. ft./min. at 7.39 in. w.g.	19.40 A
	—	Pit-bottom leakage—12,000 cu. ft./min. at 7.39 in. w.g. . .	960.00 A
	—	Old Piper workings—25,000 cu. ft./min. at 7.39 in. w.g. . .	221.30 A
	—	Pump house—8,500 cu. ft./min. at 7.2 in. w.g.	1,865.65 A
	—	Pit-top leakage—40,000 cu. ft./min. at 7.2 in. w.g.	84.24 A
Quantity 170,000 cu. ft./min.		Combined resistance in parallel	4.74 A
w.g. . . 7.4 in.		Add for fan drift (in series) . .	0.13 A
Resistance 4.80 Atks.		Total system resistance from analysis	4.87 Atks.

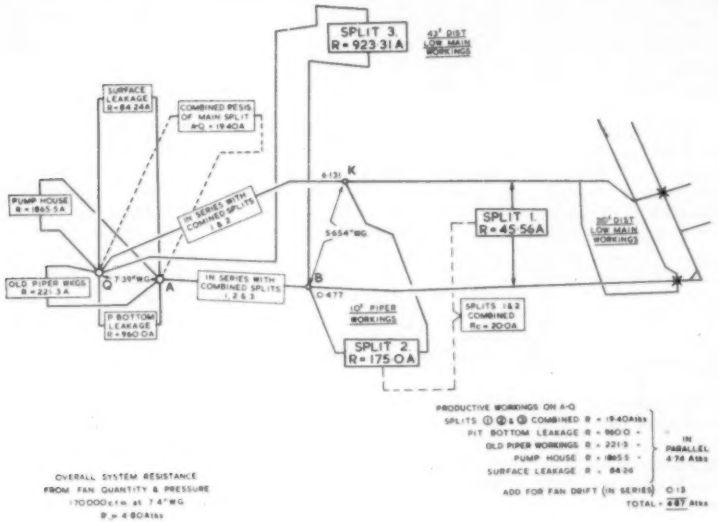
SPLIT 3
R = 923·31A
43' DIST LOW MAIN WORKINGS
SURFACE LEAKAGE R = 84·24A
COMBINED RESIS. OF MAIN SPLIT A-Q = 19·40A
PUMP HOUSE R = 1865·5A
IN SERIES WITH COMBINED SPLITS 1 & 2
6·13
K
SPLIT 1
R = 45·56A
360' DIST LOW MAIN WORKINGS
5654" WG
OLD PIPER WKGS R = 221·3A
7·39"WG
Q
A
IN SERIES WITH COMBINED SPLITS 1,2 & 3
B
0·477
10" PIPER WORKINGS
SPLITS 1 & 2 COMBINED R = 20·0A
P BOTTOM LEAKAGE R = 960·0A
SPLIT 2
R = 175·0A
PRODUCTIVE WORKINGS ON A-Q
SPLITS ① ② & ③ COMBINED R = 19·40Atks
PIT BOTTOM LEAKAGE R = 960·0 "
OLD PIPER WORKINGS R = 221·3 "
PUMP HOUSE R = 1865·5 "
SURFACE LEAKAGE R = 84·24
IN PARALLEL 4·74 Atks
ADD FOR FAN DRIFT (IN SERIES) 0·13
TOTAL = 4·87 Atks
OVERALL SYSTEM RESISTANCE FROM FAN QUANTITY & PRESSURE 170000 x 7·4" WG R = 4·80Atks

FIG. 5.—DIAGRAMMATIC LAYOUT OF A VENTILATING SYSTEM INDICATING THE MAIN SPLITTING POINTS.

being directly in parallel and could be accounted for in this example. The calculated combined resistance should be comparable to the figure of overall resistance derived from the fan quantity and the corresponding water gauge, as shown in Table 1.

Fig. 6 shows the anaiysis of resistances within the productive workings of 30s Low Main or No. 1 split; the remaining splits were not the subject of investigation, since the life of them was short and production was soon to be concentrated to 30s Low Main area only. Details of the analysis are given in Table 2.

Effect of Changes in Resistance

From the analysis it is observed that the main intake airway between points B and C is of high resistance (24.180 Atks.) and constitutes 53 per cent. of the overall split resistance, while the main return from E-K constitutes 6.67 Atkinsons or 14 per cent.

A new intake in parallel and of similar resistance to the existing intake made from B-C would reduce the intake airway resistance to 6.045 Atkinsons and, if other conditions remain the same, would produce an overall decrease in resistance in split (1) from 45.56 to 27.43 Atkinsons. The decrease in resistance produced by such a step would induce a greater flow through the split, but this would be dependent on the effect made on the overall system resistance and how the surface fan is affected by the change.

If, in addition to the above step, the splits (2) and (3) referred to in Fig. 5 were entirely sealed off, the resistance inbye of B-K would be 27.43 Atkinsons, and assuming that the resistance of the intake outbye point B and that of the return outbye K remain as before, the total split resistance would have a new value as follows:—

Resistance of section inbye of B-K, 27.43 Atkinsons.

Resistance of intake outbye point B, 1.24 Atkinsons.

Resistance of return outbye point K, 4.68 Atkinsons.

Total: 33.35 Atkinsons.

Thus, with these modifications, the single main split now operating direct from the shafts would have a resistance of 33.35 Atkinsons, compared with the original value of 19.40 Atkinsons.

If the pit-bottom water gauge remained as before (7.39 in.), the quantity flowing through the main split would be decreased in the proportion of the inverse square root of the two resistances, or from 84,500 to 64,500 cu. ft./min.

The resistance of the main intake from point A to point B (from the downcast shaft to the first splitting point), a length of 1,590 ft., is 1.24 Atkinsons and is equivalent to a resistance value of 0.78 Atkinsons/1,000 ft.

If the main intake from point B to point C (4,020 ft.) were enlarged to the same dimensions as that of A to

TABLE 2.—*Details of the Analysis of Resistances in the Productive Workings of 30s Low Main Working.*

Section.	Length (ft.)	Quantity (cu. ft./min.)	Pressure drop (in. w.g.).	Resistance of Section (Atks.).	Total resistance.	Resistance per 1,000 Atks.
MAIN INTAKE						
A—B	1,590	84,500	0.477	1.240	1.240	0.799
B—C	4,020	48,195	3.001	24.180	24.180	6.000
C—D	600	45,000	0.148	1.368	25.548	2.280
Workings inbye of D—E ..	—	45,000	1.442	13.330	38.878	—
MAIN RETURN						
E—F (1)	—	40,716	0.560	6.323 } 2.800	41.678	—
E—F (2)	—	8,580	0.560	142.400		
F—K	—	49,330	0.503	3.870	45.548*	—

* This figure of 45.548 Atkinsons agrees with the calculation of resistance for split (1) in the previous calculations of 45.56 Atkinsons.

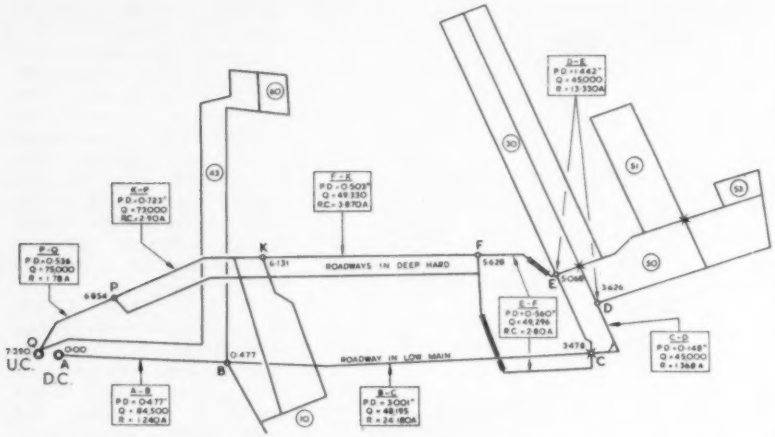

FIG. 6.—ANALYSIS OF THE RESISTANCES OF A TYPICAL VENTILATING SYSTEM WITHIN THE MAJOR WORKING SPLITS.

B, then the resistance of this section would be reduced from 24.18 Atkinsons to 3.135 Atkinsons, reducing the total split resistance (1) from 45.56 to 24.52 Atkinsons.

Assuming that the same water gauge operated on the split, the flow would increase by 36.3 per cent. or from 48,195 to 65,600 cu. ft./min.

The actual effect, however, would again depend on the change brought about on the overall system resistance and, in turn, the effect of this on the fan. In all cases where the resistance of a system or of a main split is changed appreciably, the effect on the fan must be considered. This is a factor very often overlooked.

Change in the Throughput of a Ventilating Fan

If a fan of any type revolves at a constant speed, the volume of air delivered and the pressure at which it is delivered depends on the resistance of the system on which it operates. It is usual for fan manufacturers to provide characteristic or behaviour curves relating to their fans, and these show the variation in volume, pressure and b.h.p. input requirements through a range of resistance from a maximum to open circuit.

Fig. 7 illustrates the characteristic curves of a modern centrifugal mine fan of the single-inlet type running at a constant speed of 425 r.p.m. The pressure/volume curve indicated at (*a*) shows the variation in pressure and volume throughout the full range of the resistance of the system.

At maximum resistance the fan will deliver a negligible quantity (or volume) at 8.4 in. w.g., while on open circuit it will give 280,000 cu. ft./min. at negligible water gauge.

Resistances between the above limits, indicated either in Atkinsons or as equivalent orifices, can easily be plotted on the curve. The intersecting points between the resistance curves and the pressure/volume curve indicate the duty or the pressure and volume which the fan is expected to give when operating at the respective resistances. The points of intersection are referred to as the operating points. On the curve shown in Fig. 7, if this fan is working on a system resistance of 3.13 Atkinsons (or an equivalent orifice of 30 sq. ft.), the fan will give a duty of 195,000 cu. ft./min. at 6.40 in. w.g., and its operating point is at X.

If the system resistance increases to 4.49 Atkinsons (or an equivalent orifice of 25 sq. ft.), the output at the fan will change to 177,000 cu. ft./min. at 7.41 in. w.g. The operating point will, therefore, have moved up the curve from point X to point Y. To minimize the adverse effects on a fan of increased resistance, the operating point of the fan on its curve should be well down the curve and to the right of the peak, so that if the system resistance increases, the increase in w.g. at the fan will be a maximum and the reduction in quantity a minimum.

In the case of a fan which originally operated at a point well down to the right of the peak, when the resistance of the system is increased, the flow of air

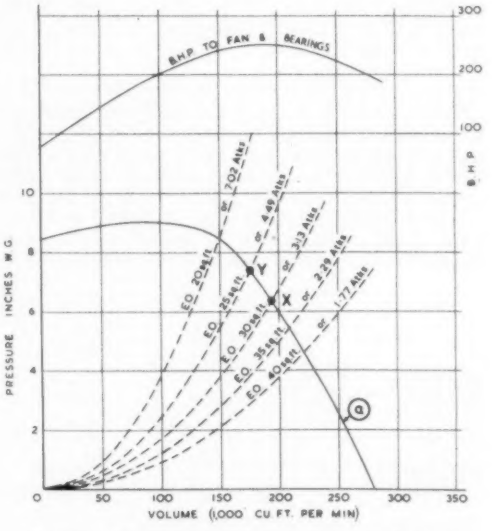

FIG. 7.—CHARACTERISTIC CURVES OF A MODERN CENTRIFUGAL MINE FAN.

through the fan is reduced and the water gauge is increased in accordance with the change indicated on the curve. There is thus a change in the quantity and pressure distribution in the system. The quantity flowing in the surface leakage split which is near the fan is increased in the proportion of $\sqrt{P_1} : \sqrt{P_2}$, where P_1 is the original water gauge and P_2 the new water gauge between the shafts at surface level.

If there was no appreciable natural ventilation effect in the shafts, the reduced flow down the shafts will result in a smaller pressure drop in them and may result in a slightly increased water gauge in the pit bottom, creating an increase in flow in all splits in which resistance has not changed.

In the split in which the resistance has increased (and this has affected the fan) the reduction in flow within it will depend on the new water gauge established in the pit bottom and on the increase in the resistance within the split.

In the first example of modification of resistance to the system, previously referred to, the combined effect of making a new intake airway of equal resistance and in parallel to the existing one (B-C in split (1)) and of closing the splits (2) and (3) has been to increase the main split resistance (on A-Q) from 19.40 Atkinsons to 33.35 Atkinsons.

Considering all the other splits in parallel within the system as before, and these resistances have remained constant, the system resistance has thus changed from 4.8 Atkinsons to 6.10 Atkinsons, or the equivalent orifice of the mine has decreased from 24.25 sq. ft. to 21.4 sq. ft.

If Fig. 8 represents the curve of the particular fan, then the operating point will move from point S to point T, and the flow at the fan will be reduced from 170,000 to 156,750 cu. ft./min., and the water gauge will be increased from 7.4 in. to 7.95 in.

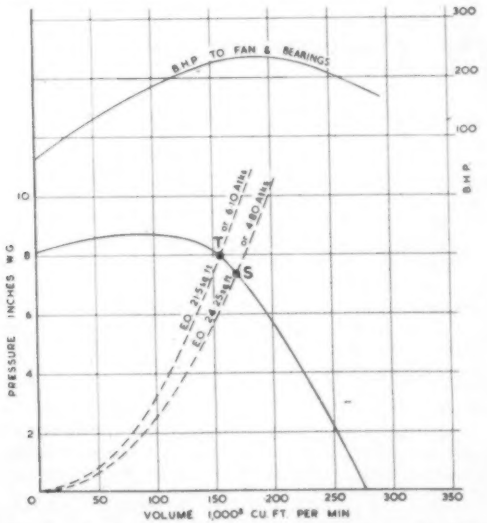

FIG. 8.—CHARACTERISTIC CURVES OF MINE FAN SHOWING THE CHANGE IN OPERATING POINT WITH CHANGES IN THE RESISTANCE OF THE VENTILATING SYSTEM.

If there is no natural ventilation effect in the shafts, the water gauge now operating in the pit bottom will be 7.95 in. and the resultant flow of 66,600 cu. ft./min. may be calculated from the new pressure of 7.95 in. water gauge and the resistance of 33.35 Atkinsons.

In the operation of many of the older types of fan at collieries, their present operating point may be at the peak of the curve or even to the left of the peak. This condition has been brought about by the fan having to operate on an increased system resistance resulting from concentration or a reduction in the number of main splits, or from a general increase in the resistance due to rapid advance of the faces (and, therefore, from the necessity of having to pass larger volumes of air over longer distances), or by deterioration in the size of main airways.

These fans, in many cases, have been speeded up to their maximum safe speed on account of these changes in resistance with a view to obtaining the increased pressures required to give satisfactory ventilation. With these conditions, any further increase in the system resistance will result in the operating point moving still further beyond, and to the left of the peak, and this may give rise to a decrease in both the quantity flowing at the fan and the water gauge. In consequence there will be a decrease in flow in all splits, and the only alternative in these cases is to open out a new area or a new seam to provide a new main split and thus decrease the overall resistance. This should be done in good time, or as soon as the position is envisaged, since the output in the most distant split in which difficulty is likely to be experienced, may have to be controlled to the ventilation available.

Causes of Change in the Resistance

Changes in the resistance of a system may be brought about by:—(*a*) An increase or decrease in the number of main splits in parallel; (*b*) an increase or decrease in the number of parallel main airways; (*c*) an increase or decrease in the leakage at the surface airlock and elsewhere underground, since these may be considered as splits in parallel; (*d*) deterioration or improvement in the cross-sectional area of main airways; and (*e*) the use of regulators.

(*a*) *Change in the Number of Splits.*—Concentration of faces to one area results in fewer main airways and a reduction in the number of main splits. If, at a mine, there are several equal main splits, then if concentration is introduced, the resistance is increased in the ratio of the inverse square of the reduction. Furthermore, the pressure requirement to give the same flow through the system increases in the same ratio.

(*b*) *Change in the Number of Parallel Main Airways.*—Paralleling main airways is a great advantage. If a new airway of equal resistance to an existing one is put in parallel, then the combined resistance of the two together is one quarter of the original value. In general, for equal resistances, the combined resistance is reduced in the ratio of the inverse square of the number used.

(*c*) *Changes in Leakage.*—Leakage at the surface airlock and leakage elsewhere underground may be

regarded as splits in parallel within the system. It is to be noted that in the case of the surface leakage, if this could be entirely sealed off the system resistance increases and the increase in flow elsewhere (*i.e.* in the underground workings) depends on the effect of this increase in system resistance on the surface fan and the amount by which it increases the operating water gauge by the movement of the operating point.

In some cases relating to older fans the effect may be detrimental on the flow elsewhere if the operating point of the fan on its curve is at its peak or to the left of the peak.

(*d*) *Change in Cross-sectional Area of Main Roadways.*—Due to the rapid advance of faces and to their relatively short life in some cases, the length of main airway outbye the splitting point increases rapidly and, in consequence, necessitates having to pass larger volumes of air through longer lengths of airway. Furthermore, any face that ceases production and is drawn off, introduces one, or, in some cases, two, leakage points, and thus a larger volume of air is required in the system to maintain the same standard of ventilation at the faces.

Main airways should not be allowed to deteriorate, but should be enlarged progressively adequately to accommodate future air requirements.

(*e*) *Use of Regulators.*—Regulators are artificial resistances or may be termed pressure dissipators. A main split near the shafts generally requires regulation, otherwise too large a quantity would flow in the split. The regulator dissipates sufficient pressure, such that the net pressure on the split itself inbye of the regulator is reduced.

A regulator in a return airway from a face may reduce the flow of air on that face, but its effect on the other unregulated faces depends on how the pressure on them is changed. If there exists a pressure between intake and return of, say, 0.75 in. water gauge at the splitting point, then, to change the quantity flowing in an open face split, this pressure has to be increased in accordance with the flow formula $P = RQ^2$. To do this, regulation in one of the faces has to be very severe, sufficiently severe to affect the fan so that both the water gauge and the quantity are changed.

Regulators in face airways can only be used to reduce the flow in any face or sub-split where there is a surplus of air. They cannot be relied upon for making an appreciable change elsewhere unless they affect the surface fan and its output, thus creating a smaller flow through the trunk airways, and, therefore, a lower pressure drop down to the point of splitting, resulting in an increase in operating water gauge at that point.

In cases within a system where the main trunk airways constitute the majority of the resistance, regulation in any one face beyond the splitting point is likely to have little effect on the overall resistance and therefore, on the ouput of the fan. There will thus be little change in quantity by doing this on the remaining faces.

(*To be concluded*)

SAFETY FIRST at

NACM Edinburgh Conference

PROGRAMME details of the 1961 annual general meeting and conference of the National Association of Colliery Managers, to be held at Edinburgh on June 6, 7, and 8, are now complete and are incorporated in an attractive brochure available from the Hon. Secretary, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. Copies of the brochure are being sent out to members next week, but the association cordially invites all others interested in the conference to apply for the brochure.

Theme of the Edinburgh conference will be "Progress—with Safety." The various technical papers will emphasize the fundamental changes in practice that have taken place within the last decade. The safety organization necessary for accident prevention will be discussed; the research currently being carried out and the measures taken to improve the standard of mining equipment will be outlined; the lessons to be learned from major mining disasters will be considered, and an appraisal will be made of modern forms of roof support in relation to strata control, bearing in mind that falls of ground remain the most prolific source of mining accidents.

All aspects of this vital subject will be covered in papers by several of the industry's leading experts. The conference will be under the presidency of Mr. H. H. Wilson, who will give his address at the annual meeting on the opening day.

Edinburgh is an ideal centre for such a conference in many ways. In addition to the technical sessions, there will be a very full programme of social activities, including a competition for the Commodore King Golf Trophy and an impressive programme of events for the ladies.

AN ADDENDUM to British Standard 449, "The Use of Structural Steel in Building," has just been published. The addendum covers the use of cold formed steel sections in building.

WORK HAS BEEN STARTED by the British Standards Institution on the revision of BS 2567, "Steel Roller Conveyors." Revision is necessary to incorporate new types and sizes of steel roller conveyors introduced since the standard was first published.

A NEW RECIPROCATING MOULD CYCLE TO IMPROVE SURFACE QUALITY OF Continuously Cast Steel

by

J. Savage,

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SUMMARY

STEEL cast continuously at relative high speeds in reciprocating moulds is often characterized by the presence of fine lateral surface markings having a substantial regular spacing. While these defects do not normally give rise to difficulties in rolling, they almost certainly produce mechanical weakness of the ingot shell below the mould, and so prevent the attainment of optimum withdrawal speeds.

It is suggested that the formation of these lateral surface defects is most probably initiated at the boundary of the meniscus by some form of " viscous drag " exerted by existing reciprocating moulds on newly formed elements of the ingot shell, as it is shown that normal frictional force between the ingot and mould is unlikely to be sufficiently high to cause rupturing of the ingot shell.

Existing moulds of the Junghans-Rossi type are based on a reciprocating cycle characterized by both a high acceleration and a high return velocity following the downstroke of the mould. It is shown that these two factors probably control respectively both the rate of application of stress and the maximum stress induced by the mould in the ingot shell, and therefore have a vital bearing on the tendency for the mould to rupture the ingot shell.

The theory of a new form of reciprocating cycle developed by the Continuous Casting Company, Limited, is outlined, and it is demonstrated how the critical parameters of stress rate and maximum stress transmitted by the mould to the ingot shell can be controlled. The reciprocating cycle applied to the moulds on the continuous casting plant to produce killed and rimming steel slabs, which is now being built by the Continuous Casting Company, Limited, for the Steel Company of Wales, Limited, will be based on the new principles outlined in this paper.

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INTRODUCTION

Following its introduction in 1933, the reciprocating mould system for the continuous casting of non-ferrous metals by the Messingwerke Schwarzwald[1] has been adopted widely in recent years on continuous casting machines for producing semi-finished sections of steel in slab, square, and round sections. This original mould cycle, the basis of the Junghans-Rossi process, is extremely simple. The mould is caused to move downwards at the same speed as the ingot for a distance of about 1 in., and the mould movement is then rapidly reversed at three times the speed of the descending ingot. Consequently, for three quarters of the casting time there is no relative movement between the mould and ingot.

Following research work carried out by BISRA,[2] it was first pointed out that the great value of this form of mould movement was the automatic healing, on the mould downstroke, of ruptures which may have been produced in the ingot shell during the rapid upstroke of the mould. It was also proposed that the important parameter was not the vertical distance travelled by the mould, but the time of downward travel (distance/casting speed). In other words, as casting speeds are increased it is also desirable to increase the distance of mould movement, so that the time of mould down travel is of the order of 0·5 to 1 sec. It has been found empirically that this interval is normally sufficient, depending on the grade of steel, to provide an adequately strong bridge of freezing metal between ruptured sections of the ingot shell.

As the Junghans mould cycle was developed empirically, it is hardly surprising that later work should have led to improvements in some most important respects. The reasons for the limitations of this original cycle and the principles underlying methods of improvement are now examined.

BRIEF ACCOUNT OF EXISTING MOULD ACTIONS

Fixed, Flexibly Mounted, and Reciprocating Moulds

As is well known, aluminium is cast continuously in very simple fixed moulds, at speeds which are of the order of a few inches/min. It has also been demonstrated that steel can be cast at low speeds in relatively simple moulds; for example, when these are mounted flexibly. [2,3] Attempts to cast steel in fixed moulds at speeds normally required commercially lead to almost immediate failure by liquid steel pouring from the lower end of the mould as a consequence of rupturing of the solid shell of steel in the mould.[2] For this reason, as the need to raise the casting speed increases, so it becomes necessary to make use of reciprocating moulds.

BISRA "Compression Release" Reciprocating Mould

BISRA concluded that the Junghans/Rossi reciprocating cycle, having no relative velocity during the mould downstroke, could conceivably lead to adhesion between the mould and the ingot skin in this period of the cycle. Accordingly, the possibility would then arise of tearing of the shell on the subsequent high-speed upstroke. In order to eliminate this source of potential trouble, it was proposed to provide a slight overtaking action of the mould relative to the ingot surface during the mould downstroke.[4]

The mould movement is synchronized with the ingot withdrawal, but in such a way that the mould downspeed exceeds the ingot speed by a predetermined amount of the order of 5 per cent. Consequently, the ingot skin is subjected to a small compressive stress on the mould downstroke, assuming that a mechanical force is transmitted to the ingot shell by the mould.

STRESS IN INGOT SHELL DUE TO MOULD FRICTION

Despite the BISRA refinement of the downstroke of the Junghans cycle, it has been observed that when casting at high speeds, lateral marks are obtained on the ingot surface which resemble fine laps. While individually these laps are somewhat irregular in shape, they are substantially regular in spacing (Fig. 4; see also Figs. 56, 58, and 60 of Ref. 5).

Any tearing of the ingot shell must, of course, arise from an excessive stress being applied. Hitherto, it has been assumed that such stresses are obtained due to friction between the mould and ingot surface. This possibility is now examined. As the breaking stress of the ingot shell at any position must depend on its thickness at the point considered, it is thought worth while to re-examine the time dependence of this important parameter.

Rate of Solidification in a Continuous Casting Mould

Hitherto, it has generally been assumed that the rate of solidification of steel in a continuous casting mould obeys the approximate conventional ingot relation

$$y_{cm} = 2.5\sqrt{t_{min.}} \quad \ldots\ldots\ldots\ldots \quad (1)$$

Alternatively, this relation may be given as

$$y_{cm} = 0.32\sqrt{t_{sec.}} \quad \ldots\ldots\ldots\ldots \quad (2)$$

It has also been suggested that as continuous casting moulds are of water-cooled high-conductivity copper, then the freezing rate is considerably greater than is obtained in normal ingots. There is no theoretical or experimental evidence available to support this assertion. In the case of steel at the very early stages of solidification, either in a continuous casting or in a conventional mould, it is considered that the above relation is far from adequate.

In Appendix I it is shown that the experimentally derived conventional ingot formula given above is in good agreement with a theoretically derived formula for large ingots, but only when the surface temperature of the ingot in the mould is assumed to be constant at a value of about 1,100 deg. C., as is known by direct experiment[6] to be a reasonable assumption for a large proportion of the freezing time. However, in the early stages of solidification, the ingot surface temperature is considerably higher than 1,100 deg. C. and changing fairly quickly with time, so that the rate of solidification in this period cannot be given by relation 1. The rate of solidification in a continuous casting mould in the first few seconds and probably in a conventional ingot in the very early stages, is shown to be given more closely by the relation

$$y_{cm} = 0.12t_{sec.} \quad \ldots\ldots\ldots\ldots \quad (3)$$

An Evaluation of the Effect of Normal Friction on Stress in the Ingot Shell

In Fig. 1 an element of ingot shell ABCD is considered as pressed against the mould by the liquid

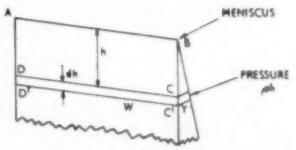

FIG. 1.—ELEMENT OF INGOT SHELL SOLIDIFYING AND SUBJECTED TO FERROSTATIC PRESSURE NEAR MENISCUS.

metal interior. CD has depth h from the meniscus, y is the thickness of solidified shell at CD, and w is the width of the element.

The force exerted by the liquid metal on the element CDD_1C_1 is then $\rho hwdh$ where ρ is the density of the liquid steel. Consequently, the total frictional F force exerted on the element ABCD is given as

$$F = \mu\,\rho\,w\,h^2/2 \text{ gm.} \quad \ldots\ldots\ldots \quad (4)$$

when μ is the coefficient of friction between the steel and mould surfaces.

The stress S gm./cm.^{2} induced in the solid shell at depth h is then $\mu\rho h^2/2y$. Taking y as 0·12t or 0.12h/v (Appendix I), then

$$S \sim 4\,\mu\rho hv \text{ gm./cm.}^2 \quad \ldots\ldots\ldots \quad (5)$$

The work of Postnov and Gulyaev[7] indicates that

nearing the melting point, the tensile strength of steel is increasing at a rate of about 500 gm./cm.² per deg. C. A heat transfer rate from the steel to the mould at the initial stage of freezing of 60 cal/cm.² sec. (Appendix I) requires a rate of fall of the mean temperature of the ingot shell of about 50 deg. C. per sec. (Appendix II). Combining these results, it may therefore be inferred with sufficient accuracy for present purposes that the tensile strength S_t gm./cm.² is related to the freezing time t seconds by:—

$$S_t \sim 2.5 \times 10^4 t = 2.5 \times 10^4 h/v \quad .. \quad (6)$$

Consequently, from equations 5 and 6, the induced stress S should exceed the breaking stress S_t when

$$4\mu\rho v > 2.5 \times 10^4/v \quad ..... \quad (7)$$

or, taking ρ as 7.5 gm./cm.³, approximately when

$$v > 30/\sqrt{\mu} \quad ..... \quad (8)$$

A reasonable value of μ for an unlubricated mould would be 0.25. Consequently, the estimated casting speed required to cause rupture due to stress induced by mould friction would have to exceed ~ 60 cm./sec. or 120 ft./min.

It is an observed fact that rupture occurs at far lower speeds (~ 5 ft./min., 2.5 cm./sec.), which condition requires a value of $\mu \sim 100$. This is highly improbable unless welding occurs. While local welding may conceivably occur sporadically, possibly due to slag particles entrapped in the shell surface, such a localized and highly irregular phenomenon could not provide a consistent cause and account for the very regular tearing action now under consideration.

However, abnormally high friction may conceivably occur due to the following cause. If for any reason the partially solidified cast section distorts in the mould—for example, if a square section tends to become rhomboidal—then the corners on the diagonal which is trying to expand may be subjected to an abnormally high pressure. This in turn might lead to a friction level at the corners which is considerably in excess of that given by the pressure of the liquid metal alone, and so reduce the calculated velocity derived above at which tearing occurs. Whether such high pressures could be transmitted by a hot thin material having mechanical properties which are probably plastic is, however, a matter of conjecture.

For simplicity, in the preceding calculation no account has been taken of the reduction in the normal pressure on the solid shell of the ingot which results from the elastic pull on the shell due to thermal contraction. When this factor is introduced, then a far higher estimated value of μ is required than derived above to produce tearing of the shell at normal casting speeds.

Postnov and Gulyaev,[7] when carrying out a more precise calculation than the preceding, also arrived at the conclusion that it is highly improbable that normal sliding friction can be sufficient to produce tearing of the ingot shell in the mould. It may therefore be concluded that some other mechanism accounts for the observed rupturing of the ingot skin.

THEORY OF CYCLIC FORMATION OF INGOT SHELL

It is now proposed that the formation of the lap marks is initiated by some phenomenon which occurs at the liquid meniscus in the mould. The initial solid skin formation at meniscus level probably occurs cyclically rather than continuously, as shown in Fig. 2.

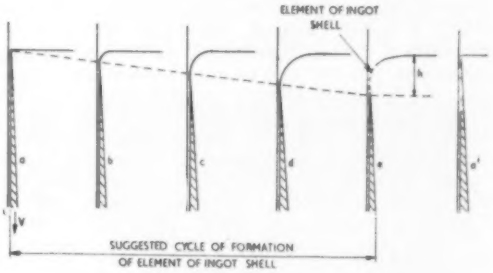

FIG. 2.—PROPOSED MECHANISM OF CYCLE FORMATION OF INGOT SHELL.

At the beginning of a cycle (Fig. 2*a*) the solid skin already formed pulls down the meniscus boundary at a velocity v. The height of the meniscus increases steadily until an unstable condition is reached (Fig. 2*e*) where the surface tension forces can no longer support the liquid metal head.

This condition will be reached when

$$h = [2T(1 - \cos\phi)/\rho g]^{\frac{1}{2}} \quad .... \quad (9)$$

where T is the surface tension of liquid steel, ϕ the supplement of the angle of contact, ρ the density of the steel, and g the acceleration due to gravity.

At this stage, it is suggested that the boundary of the meniscus will be pushed rapidly towards the mould. The beginning of the subsequent cycle is shown in Fig. 2*a*.[1]

If this assumption be correct, then the skin will be formed intermittently in lengths equal to the value of h given by the above relation. In order to obtain the probable order of h, a value of T of 1,835 dynes/cm. is taken, as measured by Kozakevitch and Urbain[8], for relatively pure liquid iron. Taking ϕ as 135 deg. and ρ as 7.5 gm./cm.³, then $h \sim 4$ mm.

Taking the surface level of the liquid steel as constant in space, as is the normal case in continuous casting, when the metal supplied from the tundish is in balance with the volume withdrawn in unit time, then the frequency of the cycle of skin formation will be v/h per sec., v being the ingot withdrawal velocity in cm./sec. and h the maximum stable height of the meniscus. It is, therefore, estimated that the frequency will be approximately 2.5 v. This frequency is then calculated to range from about 9 to 25 per sec. as the casting speed increases from 7 to 20 ft./min. (3.5 to 10 cm./sec.), these frequencies being rather too high for normal visual observation.

The above theory, predicting the probable frequency of skin formation, indicates that a cycle will occur several times during each period of upward movement of the reciprocating mould. In a typical

example of a mould upward speed of 30 ft./min. and a stroke of 2 in., the time of upward movement would be 0.33 sec. In this case the casting speed would be around 10 ft./min. (5 cm./sec.), giving a calculated frequency of skin formation of 12.5/sec. Consequently, the cycle would occur about four times during the mould upstroke.

During the time of one cycle of skin formation, it is further suggested that freezing is already occurring at the curved surface of the meniscus, due to the heat which is being radiated. Normally, where severe agitation of the meniscus occurs, due to the incoming liquid steel jet, and also in those surface areas which may be markedly affected by recirculation of the liquid steel, freezing would hardly be feasible. However, at the boundary of the meniscus the liquid metal is relatively quiescent, so that some degree of solidification is considered to be probable, as was also suggested by Thornton[9] in the case of conventional ingot casting.

It may be shown that the rate of solidification would be given very closely by

$$\frac{dy}{dt} = \frac{H}{\rho L} \quad \ldots\ldots\ldots\ldots \quad (10)$$

where H cal./cm.^{2} sec. is the rate of heat loss by radiation.

Now H may be estimated from Stefan's Law as 6 cal/cm.^{2} sec., taking the emissivity of liquid steel as 0.4 and the absolute temperature as 1,800 deg. C. Taking ρ as 7.5 gm./cm.^{3}, and L as 64 cal/gm., then equation (10) becomes

$$y_{cm} = 0.012 t_{sec} \quad \ldots\ldots \quad (11)$$

The time available for this initial freezing at the boundary of the meniscus, according to the previous discussion on skin formation, is $\frac{1}{2.5v}$ sec., where v is in cm./sec. Consequently, the calculated thickness at the time the meniscus breaks against the mould will be given by

$$y = \frac{0.012}{2.5\,v} \text{ cm.} = \frac{1}{200\,v} \text{ very nearly} \quad .. \quad (12)$$

If we suppose that this very thin skin is subjected to some form of " viscous " drag during the upstroke when it is pushed towards the mould, then the magnitude of this force will be directly proportional to the relative velocity V between the ingot shell and the mould. On the upstroke this " viscous " force kV will rise to a value of $k(N + 1)v$, where N is the ratio of the upward mould speed and the casting speed, and k is some constant which may be expected to depend on a number of factors such as the grade of steel, mould material, and type of lubricant. The maximum stress S in the newly formed element of ingot shell will then be proportional to the ratio of the maximum " viscous " force induced and the thickness of the shell, so that

$$S \propto (N + 1)\, v^2 \quad \ldots\ldots\ldots \quad (13)$$

Equation 13 indicates that the maximum stress induced in the newly formed ingot shell, increases linearly with the value of N, and with the square of the casting speed. However, with many materials, the criterion of fracturing depends not only on the maximum stress but also very markedly on the rate at which the stress is applied. In the case considered, the stress rate is proportional to dV/dt, the upward acceleration of the mould following its downstroke at uniform speed. This very important aspect of mould cycles is dealt with more fully later.

EXPLANATION OF OBSERVED " LAP-MARK " FORMATION

Fig. 3*a* indicates a shell of the solidifying ingot in the mould at the time the mould is just beginning its upstroke. It is postulated in the preceding section that when the stress-rate and maximum stress are sufficiently high, the thin and weak shell is broken near the meniscus level at position P_1. The top element of the shell is then carried upwards by the

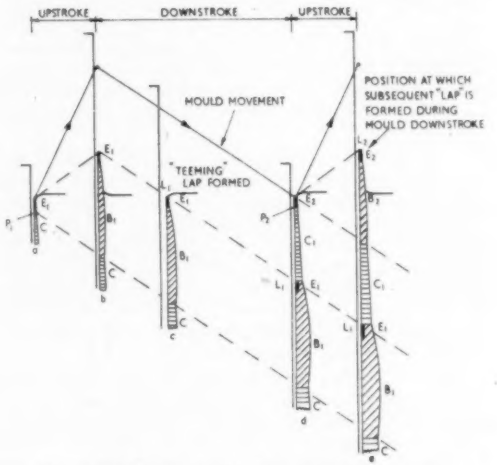

FIG. 3.—MECHANISM OF LAP-MARK FORMATION.

mould, and it is assumed that during the upstroke some slipping may occur between the surface of the mould and the element E_1. Consequently, E_1 is carried upwards by a smaller distance than the mould stroke, and arrives say at the position shown in Fig. 3*b*. In this time, element C has continued its downward movement at the casting speed. Consequently, a substantial gap between E_1 and C is formed, which begins to freeze as the element B_1, Fig. 3*b*.

The mould downstroke then begins, and continues to the point shown in Fig. 3*d*. In this period the stress applied by the mould to the ingot shell is either zero or slightly compressive, depending on whether the mould moves at the same or at a slightly greater speed than the ingot. Consequently, only a very weak mechanical link such as B_1 is required to permit the element C to move the element E_1. Now when the upper edge of E_1 penetrates the liquid steel meniscus, it is suggested that a fine lap L_1 is produced, as indicated in Fig. 3*c*. During the remainder of the downstroke, the lap L_1 passes beyond the meniscus level to reach the position shown in Fig. 3*d*. When the mould is again reversed on the subsequent cycle, it is proposed that tearing occurs again as shown at P_2, and the cycle of events is repeated.

The spacing between successive lap marks L_1, L_2, L_3, etc., would be the distance travelled by the element E_1 from the position indicated in Fig. 3*b* to the position shown in Fig. 3*e*, *i.e.*, the distance travelled by the ingot shell in one complete mould cycle. This is, of course, greater than the vertical stroke of the mould.

Let the mould downward velocity be v cm./sec.
" " upward " " Nv cm./sec.
(In the Junghans cycle, $N = 3$.)
Let S cm. be the mould stroke.
" T sec. be the time of the complete mould cycle.

$$\text{Then} \quad T = \frac{S}{v} + \frac{S}{Nv} = \frac{S(1+N)}{Nv} \quad \ldots \quad (14)$$

When the ingot and mould have the same downward speed, then:—

$$\text{Average "lap" spacing} = \frac{S(1+N)}{N} \text{ cm.} \quad (15)$$

When "compression release" is applied, where the ingot speed is Rv ($R < 1$ and ~ 95 per cent.) then:—

$$\text{Average "lap" spacing} = \frac{Rs(1+N)}{N} \text{ cm.} \quad (16)$$

It should be noted that the calculated spacings between successive lap marks are only average values in any specific case. There may well be some variation about the mean value, owing to differences in the degree of slip between the mould and ingot shell in a series of reciprocating cycles.

If the mechanism proposed be correct, then the following conclusions could be drawn:—

(1) The average spacing between successive tear marks is not equal to the mould stroke, but to the distance travelled by the ingot in one complete mould cycle, as calculated above.

(2) The phenomenon would be observed in the mould as a lifting of the upper part of the shell above the meniscus on the mould upstroke, with the possibility of liquid metal being carried upwards by the inner face of the torn shell. Conversely, it might appear superficially to an observer as a sudden fall of the meniscus inside the solidified shell.

(3) The ingot surface between successive laps should comprise three zones, E_2, B_2, C_1, as indicated in Fig. 3*e*. E_2 and C_1, adjacent to the lap marks, should have a normal "as-cast" appearance, while the intermediate zone B_2 should have a different texture owing to an alternative mechanism of its surface formation below the meniscus.

Detailed observations on the appearance of the as-cast surface of a 3-in. square section of En 45 steel, cast with a reciprocating mould at 12 ft./min. on a semi-continuous casting machine in the BISRA laboratories, support the above predictions, as may be seen in Fig. 4. This is a photograph of a replica of the as-cast surface from which scale was first removed, followed by chemical cleaning.

How far these effects may be observed will depend on what changes occur in the texture of the steel surface after leaving the mould, due, for example, to scale formation, secondary water cooling, and the passage of the ingot through guide rollers and withdrawal rolls. However, such lap marks, however fine they may be, must be regarded in some cases as a potential source of trouble. While they do not result in break-out of liquid metal at the bottom of the mould, owing to the healing action of the reciprocating mould, the defects are likely to cause localised reduction of the mechanical strength of the skin, and therefore to impose a limit on the casting speeds which might otherwise be reached.

It is therefore considered important to analyse reciprocating mould actions more critically than hitherto, with the object of eliminating the phenomenon of lap-mark formation, or at least of extending

FIG. 4.—LATERAL MARKS ON THE SURFACE OF A CONTINUOUSLY CAST INGOT. (DIRECTION OF CASTING IS FROM TOP TO BOTTOM.)

the casting speed limit beyond that at which the effect is obtained with existing mould cycles.

IMPORTANCE OF THE MOULD CYCLE ON THE STRESS APPLIED TO THE INGOT SHELL

From the preceding, we may first restate what are now considered by the author to be desirable features of a mould cycle. These are:—

(1) A certain time t secs., preferably not less than 0.5 sec. and, with no disadvantage, not exceeding 1 sec., should be allowed during the downstroke in which time the mould moves at uniform speed equal to, or preferably slightly greater than, the casting speed v. This order of time is required to produce a satisfactory bridge of metal to be formed between ruptured sections of the shell which may be produced during the mould upstroke.

(2) The change from this downward movement at uniform speed should be effected by the smallest possible deceleration downwards and subsequent acceleration upwards. This enables some limit to be imposed on the rate of application of stress to the ingot shell.

(3) The uniform upward speed following stage 2 above, and, consequently, the relative velocity between the mould and ingot, should be as low as it is convenient to make it. This limits the maximum steady stress applied.

(4) The time of upward travel should be as short as possible, so restricting the time over which stress is applied.

(5) The change of movement of the mould from its upward travel at uniform speed to its downward travel at uniform speed may be made very rapidly without ill effect, as this stage represents an unloading of stress in the ingot shell.

Junghans-Rossi Cycle

As mentioned earlier, the Junghans-Rossi mould cycle comprises the features indicated in Fig. 5, a velocity/time characteristic. Along AB the mould

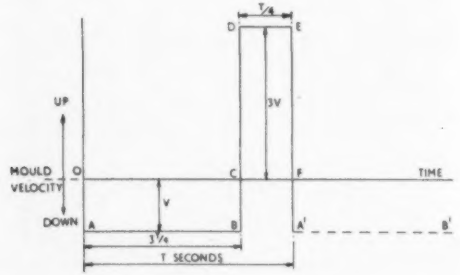

FIG. 5.—VELOCITY-TIME CHARACTERISTIC OF THE JUNGHANS-ROSSI MOULD CYCLE.

moves at the casting speed v for a time $\frac{3T}{4}$ sec., where T sec. is the total cycle time. The mould is then moved upwards very rapidly, as shown by BCD, to reach a speed of $3v$, which is maintained for $\frac{T}{4}$ sec. From the preceding theory it will be evident that the velocity/time relation may also be taken to represent some function with time of the stress induced in the ingot shell formed at the meniscus, when the stress is measured from a zero level of no relative velocity, which is, of course, along ABA′B′.

Consequently, while the Junghans-Rossi cycle gives zero stress along AB, this is immediately followed by an undesirably rapid rate of stressing to reach a certain level of stress along DE.

New Mould Cycle

The mould cycle now proposed* has the characteristics shown in the velocity/time diagram (Fig. 6). At position O, the mould is at the bottom of its

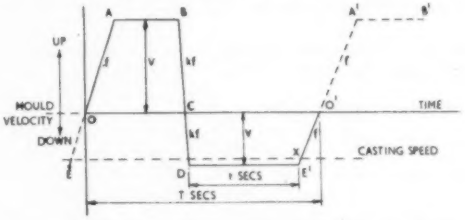

FIG. 6.—VELOCITY-TIME CHARACTERISTIC OF NEW MOULD CYCLE.

stroke. It is then given a uniform acceleration f in./sec.^{2} along OA, until it reaches an upward velocity V in./sec. at A. This velocity is then maintained along AB, and at B the mould is decelerated at kf in./sec.^{2} ($k > 1$) to reach the top point of the mould stroke at C. The mould is then accelerated, also at kf in./sec.^{2} along CD, to reach the required mould downward speed v at D, slightly in excess of the casting speed (British Patent 806,803). The mould then maintains this uniform speed v along DE for a time t seconds (in practice, 0.5-1 sec.). At E′, the mould decelerates at f in./sec.^{2} to reach the bottom of the stroke at O′, and is then accelerated upwards, also at f in./sec.^{2}, to repeat the same cycle.

$$\text{Let } \frac{t}{T} = R \text{ and } \frac{V}{v} = N.$$

The relation between time and stress in the ingot shell may again be taken as represented on some arbitrary scale by OABCDE′O′, where the casting speed ordinate represents zero stress. Along DE′ the stress is slightly compressive. Very soon after the mould terminates its downward movement at uniform speed, the stress becomes zero at X, and then becomes a tensile stress which increases at a constant and controlled rate along XO′A′. Along AB, equivalent to A′B′, the stress remains constant, and this uniform tensile stress is then released along BCD, again at a uniform rate, which may be as rapid as it is convenient to make it. For a given value of v, which, of course, depends entirely on the desired withdrawal speed of the ingot, and selected

* British and foreign patents pending.

values of t and T for a specific case, it is then important to ascertain what are the optimum values which can be obtained of f, which controls the stress-rate and V which controls the maximum stress applied.

From Fig. 6, it is shown in Appendix III that the mould stroke

$$\text{S in.} = \frac{\text{N}vt}{(\text{N}+1)^2}\left[\text{N} + \left(\frac{1+\text{R}}{\text{R}}\right)\right] \qquad (17)$$

$$f = \frac{v}{2t}\left(1+\frac{1}{k}\right)\frac{(\text{N}+1)^2}{\left[\frac{\text{N}}{\text{R}}-(\text{N}+1)\right]} \qquad (18)$$

$$f\,(\text{minimum}) = \frac{2\,v\,\text{R}}{t(1-\text{R})^2}\left(1+\frac{1}{k}\right)$$

$$\text{given when N} = \frac{1+\text{R}}{1-\text{R}} \qquad (19)$$

When v, t and T are fixed, then three kinds of cycle are possible, as shown in Fig. 7 below.

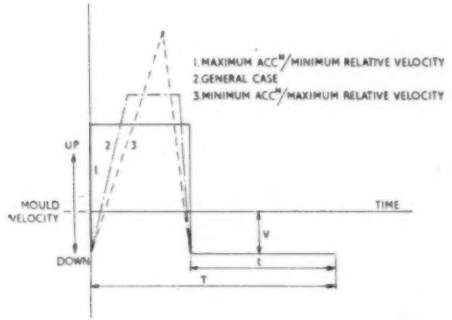

FIG. 7.—EXTREME RANGE OF VELOCITY-TIME CHARACTERISTICS OF NEW MOULD CYCLE.

From the fact that the mould moves as far upwards as it does downwards, it follows as an essential mathematical requirement that the areas above and below the time axis of the velocity/time cycle are equal in any specific example. Consequently, in Case 1 (Fig. 7) we may have an infinite acceleration and deceleration to give a minimum upward velocity V, given by $\frac{v\text{R}}{1-\text{R}}$. The second extreme case is indicated by Case 3 (Fig. 7), where the mould has no period of uniform upward velocity. This gives the minimum value of acceleration f and the maximum upward velocity $\text{V}\left[= v\left(\frac{1+\text{R}}{1-\text{R}}\right)\right]$ for given values of v, t, and T. Cycle 2 (Fig. 7) depicts a general case between the extremes 1 and 3.

A decision on the optimum cycle for a required numerical case may be made from the following considerations.

Let t be fixed at 1 sec., when the casting speed is 5 ft./min. (1 in./sec.). Then, from equation (18), we have:

$$f = \frac{1}{2}\left(1+\frac{1}{k}\right)\frac{(\text{N}+1)^2}{\left[\frac{\text{N}}{\text{R}}-(\text{N}+1)\right]} \qquad \ldots\ldots\ldots (20)$$

Now, by inspection, f may be reduced by making k large, and it has already been explained that there is no disadvantage in taking this step, as the rate of unloading of the tensile stress, which depends on the value of kf, may be made as high as is convenient If, for example, we assign to k a value of 3, then in the case considered, equation (20) becomes

$$f = \frac{2}{3}\,\frac{(\text{N}+1)^2}{\left[\frac{\text{N}}{\text{R}}-(\text{N}+1)\right]} \qquad \ldots\ldots\ldots\ldots (21)$$

Fig. 8 shows the relation between f and N obtained from equation (21) for four values of R ranging from 0.75 to 0.5. It is evident that the higher the value of R, or the greater the proportion of the cycle time in which the mould is moving at uniform downward speed, the greater are the levels of mould acceleration and relative velocity required. In the case considered, where t is 1 sec., when R is 0.75, 0.67, 0.6, and 0.5, then the time interval $(\text{T}-t)$ has values of 0.33, 0.5, 0.66, and 1 sec., respectively. As is clear from Fig. 8, the small increase in the value of this time interval from 0.33 to 0.5 sec., a reduction of R of from 0.75 to 0.67, permits a very large reduction to be made in the value of the mould acceleration for any value of N between 3 and 5.

The form of the acceleration—relative velocity curves demonstrates four other main features for any specific value of R:

(*a*) The minimum relative velocity can only be attained by an infinite mould acceleration.

(*b*) The acceptance of a small fractional increase over the minimum relative velocity permits a very large reduction to be made in the mould acceleration, as the gradient $df/d\text{N}$ is very large as N approaches its minimum value.

(*c*) The minimum acceleration can only be attained by accepting the highest value of the relative velocity.

(*d*) The acceptance of a small fractional increase of the mould acceleration over the minimum attainable enables a substantial reduction to be made in the relative velocity required, as the gradient $df/d\text{N}$ is small as f approaches its minimum level.

Considering a specific value of R, for example, 0.67, the particular curve relating the value of f and N shows that by accepting a small increase of N from 2.15 to, say, 2.5, corresponding to relative velocities of about 16 and 17.5 ft./min., an increase of 10 per cent., the mould acceleration can be reduced from 83 to 33 in./sec.^{2}, a reduction of 60 per cent. Similarly, when R has the value of 0.67, an acceleration of 18 in./sec.^{2} may be obtained when N is 3.5, compared with the minimum which is feasible of 16 in./sec.^{2} when N is 5: *i.e.*, a decrease

the casting speed limit beyond that at which the effect is obtained with existing mould cycles.

IMPORTANCE OF THE MOULD CYCLE ON THE STRESS APPLIED TO THE INGOT SHELL

From the preceding, we may first restate what are now considered by the author to be desirable features of a mould cycle. These are:—

(1) A certain time t secs., preferably not less than 0.5 sec. and, with no disadvantage, not exceeding 1 sec., should be allowed during the downstroke in which time the mould moves at uniform speed equal to, or preferably slightly greater than, the casting speed v. This order of time is required to produce a satisfactory bridge of metal to be formed between ruptured sections of the shell which may be produced during the mould upstroke.

(2) The change from this downward movement at uniform speed should be effected by the smallest possible deceleration downwards and subsequent acceleration upwards. This enables some limit to be imposed on the rate of application of stress to the ingot shell.

(3) The uniform upward speed following stage 2 above, and, consequently, the relative velocity between the mould and ingot, should be as low as it is convenient to make it. This limits the maximum steady stress applied.

(4) The time of upward travel should be as short as possible, so restricting the time over which stress is applied.

(5) The change of movement of the mould from its upward travel at uniform speed to its downward travel at uniform speed may be made very rapidly without ill effect, as this stage represents an unloading of stress in the ingot shell.

Junghans-Rossi Cycle

As mentioned earlier, the Junghans-Rossi mould cycle comprises the features indicated in Fig. 5, a velocity/time characteristic. Along AB the mould

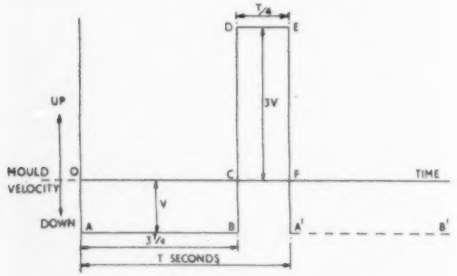

FIG. 5.—VELOCITY-TIME CHARACTERISTIC OF THE JUNGHANS-ROSSI MOULD CYCLE.

moves at the casting speed v for a time $\frac{3T}{4}$ sec., where T sec. is the total cycle time. The mould is then moved upwards very rapidly, as shown by BCD, to reach a speed of $3v$, which is maintained for $\frac{T}{4}$ sec. From the preceding theory it will be evident that the velocity/time relation may also be taken to represent some function with time of the stress induced in the ingot shell formed at the meniscus, when the stress is measured from a zero level of no relative velocity, which is, of course, along ABA′B′.

Consequently, while the Junghans-Rossi cycle gives zero stress along AB, this is immediately followed by an undesirably rapid rate of stressing to reach a certain level of stress along DE.

New Mould Cycle

The mould cycle now proposed* has the characteristics shown in the velocity/time diagram (Fig. 6). At position O, the mould is at the bottom of its

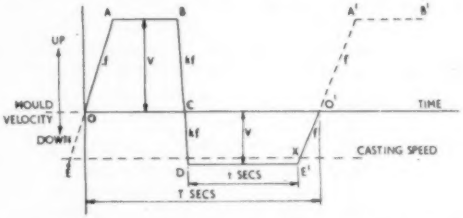

FIG. 6.—VELOCITY-TIME CHARACTERISTIC OF NEW MOULD CYCLE.

stroke. It is then given a uniform acceleration f in./sec.² along OA, until it reaches an upward velocity V in./sec. at A. This velocity is then maintained along AB, and at B the mould is decelerated at kf in./sec.² ($k > 1$) to reach the top point of the mould stroke at C. The mould is then accelerated, also at kf in./sec.² along CD, to reach the required mould downward speed v at D, slightly in excess of the casting speed (British Patent 806,803). The mould then maintains this uniform speed v along DE for a time t seconds (in practice, 0.5-1 sec.). At E′, the mould decelerates at f in./sec.² to reach the bottom of the stroke at O′, and is then accelerated upwards, also at f in./sec.², to repeat the same cycle.

$$\text{Let } \frac{f}{T} = R \text{ and } \frac{V}{v} = N.$$

The relation between time and stress in the ingot shell may again be taken as represented on some arbitrary scale by OABCDE′O′, where the casting speed ordinate represents zero stress. Along DE′ the stress is slightly compressive. Very soon after the mould terminates its downward movement at uniform speed, the stress becomes zero at X, and then becomes a tensile stress which increases at a constant and controlled rate along XO′A′. Along AB, equivalent to A′B′, the stress remains constant, and this uniform tensile stress is then released along BCD, again at a uniform rate, which may be as rapid as it is convenient to make it. For a given value of v, which, of course, depends entirely on the desired withdrawal speed of the ingot, and selected

* British and foreign patents pending.

values of t and T for a specific case, it is then important to ascertain what are the optimum values which can be obtained of f, which controls the stress-rate and V which controls the maximum stress applied.

From Fig. 6, it is shown in Appendix III that the mould stroke

$$\text{S in.} = \frac{Nvt}{(N+1)^2}\left[N + \left(\frac{1+R}{R}\right)\right] \qquad (17)$$

$$f = \frac{v}{2t}\left(1+\frac{1}{k}\right)\left[\frac{(N+1)^2}{\frac{N}{R}-(N+1)}\right] \qquad (18)$$

$$f(\text{minimum}) = \frac{2vR}{t(1-R)^2}\left(1+\frac{1}{k}\right)$$

$$\text{given when } N = \frac{1+R}{1-R} \qquad (19)$$

When v, t and T are fixed, then three kinds of cycle are possible, as shown in Fig. 7 below.

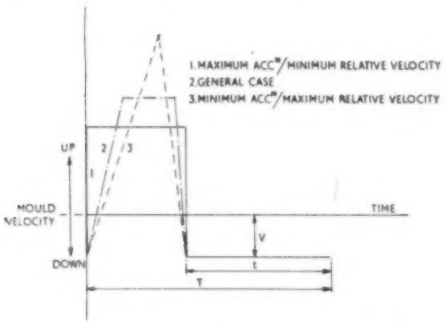

FIG. 7.—EXTREME RANGE OF VELOCITY-TIME CHARACTERISTICS OF NEW MOULD CYCLE.

From the fact that the mould moves as far upwards as it does downwards, it follows as an essential mathematical requirement that the areas above and below the time axis of the velocity/time cycle are equal in any specific example. Consequently, in Case 1 (Fig. 7) we may have an infinite acceleration and deceleration to give a minimum upward velocity V, given by $\frac{vR}{1-R}$. The second extreme case is indicated by Case 3 (Fig. 7), where the mould has no period of uniform upward velocity. This gives the minimum value of acceleration f and the maximum upward velocity $V\left[=v\left(\frac{1+R}{1-R}\right)\right]$ for given values of v, t, and T. Cycle 2 (Fig. 7) depicts a general case between the extremes 1 and 3.

A decision on the optimum cycle for a required numerical case may be made from the following considerations.

Let t be fixed at 1 sec., when the casting speed is 5 ft./min. (1 in./sec.). Then, from equation (18), we have:

$$f = \frac{1}{2}\left(1+\frac{1}{k}\right)\left[\frac{(N+1)^2}{\frac{N}{R}-(N+1)}\right] \qquad \ldots\ldots\ldots (20)$$

Now, by inspection, f may be reduced by making k large, and it has already been explained that there is no disadvantage in taking this step, as the rate of unloading of the tensile stress, which depends on the value of kf, may be made as high as is convenient If, for example, we assign to k a value of 3, then in the case considered, equation (20) becomes

$$f = \frac{2}{3}\left[\frac{(N+1)^2}{\frac{N}{R}-(N+1)}\right] \qquad \ldots\ldots\ldots\ldots (21)$$

Fig. 8 shows the relation between f and N obtained from equation (21) for four values of R ranging from 0.75 to 0.5. It is evident that the higher the value of R, or the greater the proportion of the cycle time in which the mould is moving at uniform downward speed, the greater are the levels of mould acceleration and relative velocity required. In the case considered, where t is 1 sec., when R is 0.75, 0.67, 0.6, and 0.5, then the time interval $(T-t)$ has values of 0.33, 0.5, 0.66, and 1 sec., respectively. As is clear from Fig. 8, the small increase in the value of this time interval from 0.33 to 0.5 sec., a reduction of R of from 0.75 to 0.67, permits a very large reduction to be made in the value of the mould acceleration for any value of N between 3 and 5.

The form of the acceleration—relative velocity curves demonstrates four other main features for any specific value of R:

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Considering a specific value of R, for example, 0.67, the particular curve relating the value of f and N shows that by accepting a small increase of N from 2.15 to, say, 2.5, corresponding to relative velocities of about 16 and 17.5 ft./min., an increase of 10 per cent., the mould acceleration can be reduced from 83 to 33 in./sec.^{2}, a reduction of 60 per cent. Similarly, when R has the value of 0.67, an acceleration of 18 in./sec.^{2} may be obtained when N is 3.5, compared with the minimum which is feasible of 16 in./sec.^{2} when N is 5: *i.e.*, a decrease

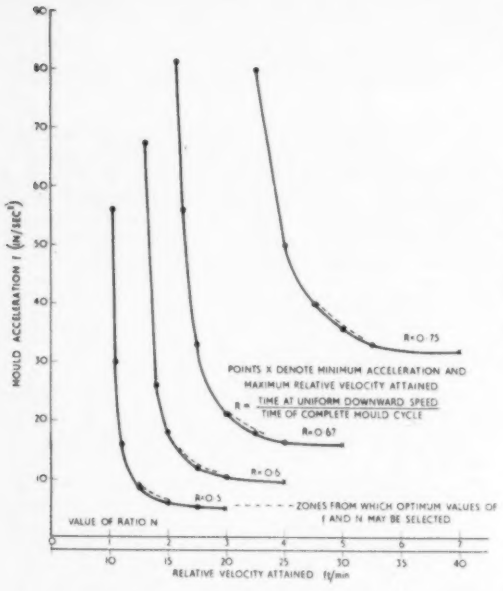
MOULD ACCELERATION f (in/sec²)
RELATIVE VELOCITY ATTAINED ft/min
POINTS X DENOTE MINIMUM ACCELERATION AND MAXIMUM RELATIVE VELOCITY ATTAINED
R = TIME AT UNIFORM DOWNWARD SPEED / TIME OF COMPLETE MOULD CYCLE
R=0·75
R=0·67
R=0·6
R=0·5
ZONES FROM WHICH OPTIMUM VALUES OF f AND N MAY BE SELECTED
VALUE OF RATIO N

FIG. 8.—RELATION BETWEEN MOULD ACCELERATION AND RELATIVE VELOCITY ATTAINED BETWEEN MOULD AND INGOT OF RANGE OF VALUES OF R.

of the acceleration at this level of only 11 per cent. requires an increase of the relative velocity of about 33 per cent.

For a given casting speed v and preferred values of t and T, it is possible by using the method outlined to decide what level of mould acceleration and uniform upward speed, which may be taken respectively as governing the rate of stress application and the maximum stress applied, can be achieved to give conditions which are most likely to reduce the tendency for rupturing of the ingot shell by the mould.

In Fig. 8, the zones of the f-N curves are shown from which specific values of f and N may preferably be selected for a chosen value of R to give the best possible compromise between the stress-rate and steady stress applied in a particular numerical case. In practice, when these values have been selected, the precise velocity-time characteristic can be derived, and from this, the mould displacement-time characteristic can be obtained. The required mould displacement with time can be produced conveniently by means of a cam which is profiled to give the required displacement. The cam rotation can then be synchronized with the withdrawal speed of the ingot, which is, of course, controlled by the drive to the withdrawal rolls, by such standard means which include mechanical, hydraulic, or electrical links or some combination of these.

Acknowledgment

The author gratefully acknowledges the invaluable assistance given by his colleague, Mr. J. S. Morton, managing director, Continuous Casting Company, Limited, in the development of the ideas presented in this paper.

APPENDIX I

The Rate of Freezing in Ingot and in Continuous Casting Moulds

It has often been suggested that an ingot in passing through a continuous casting mould solidifies at a rate given by the conventional ingot formula $y_{in.} = \sqrt{t}_{min.}$, found by Nelson[10] and Spretnak[11] to fit experimental observations on conventional ingots.

In order to try and establish a firmer basis for considering freezing rates at the very early stage of solidification, the problem has been examined theoretically and experimental data used to obtain a more useful relation for the case of continuous casting moulds than is likely to be given by the conventional ingot formula.

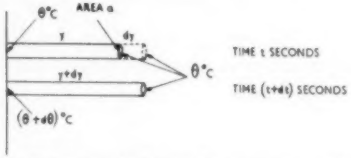

FIG. 9.—ELEMENT OF INGOT SOLIDIFYING IN MOULD.

In Fig. 9 it is assumed that the solidified element, area a, thickness y, at time t increases in thickness to $y + dy$ at time $t + dt$, and that the temperature gradient in the solid shell is linear. The heat content H_1 of the element $y + dy$ at time t is given as:

$$H_1 = ady\rho\,(L + S\phi) + ay\rho\left(\frac{(\phi + \theta)}{2}\right)S \quad \ldots\ldots\ldots(22)$$

and the heat content H_2 of the element $y + dy$ at time $t + dt$ is given by:

$$H_2 = a(y + dy)\rho\left[\frac{\phi + \theta + d\theta}{2}\right]S \quad \ldots\ldots\ldots (23)$$

where, in c.g.s. units,

ρ is the density of solid or liquid steel near the melting point;

S is the specific heat of solid or liquid steel near the melting point;

L is the latent heat of fusion;

ϕ is the uniform temperature of the solid/liquid interface;

θ is the surface temperature of the element at time t.

If H is the rate of heat loss per unit area, then

$$H = \frac{H_1 - H_2}{adt} = \frac{\rho}{2}\frac{dy}{dt}\left[2L + S(\phi - \theta)\right] - \frac{y\rho S}{2}\frac{d\theta}{dt} \quad (24)$$

neglecting the second order term containing dy, $d\theta$.

Also,

$$H = K\frac{\phi - \theta}{y} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(25)$$

when K is the thermal conductivity of the freezing steel

By equating (24) and (25), and knowing $\phi - \theta$ as a function of t, then it is possible to obtain a differential equation from which y may be obtained as a function of t.

Conventional Ingot Moulds

It is observed experimentally[6] that after the first few minutes of solidification of medium- and large-sized ingots, the value of θ decreases extremely slowly. When θ attains a value of 1,200 deg. C., a further period of 80 min. is required for the ingot to attain a surface temperature of 1,000 deg. C. Consequently, for larger ingots over a

very high proportion of the freezing time, the simplifying assumption can be made that θ has a constant value of 1,100 deg. C., so giving $\phi - \theta$ as 400 deg. C. Following this sssumption we have:

$$\phi - \theta = \text{constant} = 400 \text{ say} \quad \ldots\ldots\ldots\ldots (26)$$

$$\therefore \frac{d\theta}{dt} = 0$$

From equations (24) and (25), and taking $\phi - \theta$ as 400 deg. C., we then have:

$$\frac{\rho}{2}\frac{dy}{dt}(2L + 400S) = \frac{K\ 400}{y} \quad \ldots\ldots\ldots\ldots (27)$$

$$\therefore y^2 = \frac{1{,}600\ K}{\rho(2L + 400\ S)}\ t$$

$$\text{or } y = \left[\frac{1{,}600\ K}{\rho\ (2L + 400\ S)}\right]^{\frac{1}{2}} \sqrt{t} \quad \ldots\ldots\ldots\ldots (28)$$

Taking K as 0.07, ρ as 7.5, L as 64 and S as 0.16, all in c.g.s. units, then

$$y_{cm.} = 0.28\sqrt{t_{sec.}} \quad \ldots\ldots\ldots\ldots (29)$$

This becomes

$$y_{in.} = 0.85\sqrt{t_{min.}} \quad \ldots\ldots\ldots\ldots (30)$$

a calculated value which is in very fair agreement with measured results for conventional ingots.

Continuous Casting Moulds

From the above it will be seen that a relation of the form $y = k\sqrt{t}$ can only be valid when $\phi - \theta$ is independent of time from the beginning of freezing. In a continuous casting mould, where the ingot is only in the mould for a very short time, ranging from 10 to 60 sec., θ is not constant, but is decreasing with time from the liquidus temperature. Consequently $\phi - \theta$ is some function of t, and this relation must be known to permit equations 24 and 25 to be solved. This also applies in the case of conventional ingots in the very early stage of freezing.

Unfortunately, the relation between $\phi - \theta$ and t is not known at the early stage of solidification. However, a simple solution may be obtained from the experimentally derived heat transfer rate in the very early stages of freezing in a continuous casting mould. For a short time from the beginning of freezing, this rate of heat transfer was inferred as ~ 60 cal/cm.^{2} sec. It may then easily be shown from equation 24 that when t is small,

$$y = \frac{Ht}{\rho L} = \frac{60t}{\rho L} = 0{\cdot}12t \text{ cm. sec. units} \quad \ldots\ldots\ldots (31)$$

as terms containing the specific heat S are then negligible compared with the latent heat term.

Equation 31 gives lower values of y for very small values of t than the conventional ingot relation which is normally assumed.

APPENDIX II

Rate of Fall of Mean Temperature of the Ingot Shell at the Initial Stage of Solidification

Adopting the same notation as in Appendix I, the mean temperature of the ingot shell is $(\phi + \theta)/2$, so that the fall in the mean temperature is $(\phi - \theta)/2$.

From Appendix I we have, when t is very small,

$$y = \frac{Ht}{\rho L} \quad \ldots\ldots\ldots\ldots (32)$$

$$\text{and } H = \frac{K(\phi - \theta)}{y} \quad \ldots\ldots\ldots\ldots (25)$$

$$\therefore \frac{\phi - \theta}{2} = \frac{1}{2}\frac{H^2 t}{\rho LK} \quad \text{so that}$$

$$\frac{1}{t}\left(\frac{\phi - \theta}{2}\right) = \frac{H^2}{2\rho LK} \quad \ldots\ldots\ldots\ldots (33)$$

On substituting previously adopted numerical values, the rate of fall of the mean temperature, $(\phi - \theta)/2t$ deg. C/sec., is then calculated to be ~ 50 deg. C./sec. at the very early stage of solidification.

APPENDIX III

Calculation of Acceleration f in New Mould Cycle

In Fig. 6 let the time along AB at constant velocity V $(= Nv)$ be t_1. We then have:—

Time of complete cycle T is given as

$$T = \frac{t}{R} = \text{sum of times along OA, AB, BC, CD, DE',}$$

E'O', *i.e.*, $\frac{t}{R} = \frac{Nv}{f} + t_1 + \frac{Nv}{kf} + \frac{v}{kf} + t + \frac{v}{f}$ giving

$$t_1 = t\left(\frac{1 - R}{R}\right) - \frac{v}{f}\left(1 + \frac{1}{k}\right)(N + 1) \quad \ldots\ldots (34)$$

Also, the distance travelled by the mould in the upward direction is the sum of the distances along OA, AB and BC,

i.e. Distance of upstroke $= \frac{N^2 v^2}{2f} + Nvt_1 + \frac{N^2 v^2}{kf}$

$$= Nvt_1 + \frac{N^2 v^2}{2f}\left(1 + \frac{1}{k}\right) \ldots\ldots\ldots (35)$$

Similarly, distance of downstroke

$$= vt + \frac{v^2}{2f}\left(1 + \frac{1}{k}\right) \ldots\ldots\ldots (36)$$

As the upstroke and downstroke are, of course, identical, we have from equations 35 and 36,

$$t_1 = \frac{1}{N}\left[t - \frac{(N^2 - 1)v}{2f}\left(1 + \frac{1}{k}\right)\right] \quad \ldots\ldots\ldots (37)$$

Eliminating t_1 from equations 34 and 37 we find,

$$f = \frac{v\left(1 + \frac{1}{k}\right)(N + 1)^2}{2t\left[\frac{N}{R} - (N + 1)\right]} \quad \text{as given in equation (18)}$$

To find the minimum value of f, then by fixing the values of v, k, t and R, leaving f and N as the two dependent variables, we have from equation 18,

$$\frac{df}{dN} = \frac{v}{2t}\left(1 + \frac{1}{k}\right)\frac{(N + 1)}{R\left[\frac{N}{R} - (N + 1)\right]^2} \times \left[(N - 1) - (N + 1)R\right] \quad \ldots\ldots\ldots (38)$$

Consequently, f is either maximum or minimum when $R = \frac{(N - 1)}{(N + 1)}$. As it may be shown that $\frac{d^2 f}{dN^2}$ is positive when $R = \frac{N - 1}{N + 1}$, we have

$$f \text{ (minimum) when } R = \frac{N - 1}{N + 1} \text{ or } N = \frac{1 + R}{1 - R} \quad (19)$$

The total vertical movement of the mould, S, is, of course, given by substituting the value of f, equation 18 in equation 36. This gives

$$\text{Total vertical stroke } S = \frac{Nvt}{(N + 1)^2}\left[N + \frac{1 + R}{R}\right]$$

as given in equation 17.

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Forthcoming Events

APRIL 17

Society of Instrument Technology (Bristol Section):—Annual general meeting, followed by film show, at the University of Bristol, Department of Physics, The Royal Fort, Bristol 8, at 7.30 p.m.

APRIL 18

Institute of Marine Engineers:—Meeting at the Memorial Building, 76, Mark Lane, London, E.C.3, at 5.30 p.m. "Corrosion of Tin-base Babbitt Bearings in Marine Steam Turbines," by J. B. Bryce and T. G. Roehner.

Institution of Mechanical Engineers:—Meeting at the Chemistry Lecture Theatre, University of Leeds, at 6.30 p.m. "Influence of Rate of Strain-hardening in Machining," by P. L. B. Oxley, A. G. Humphreys, and A. Larizadeh, and "Metal Cutting and the Built-up Nose," by W. B. Heginbotham and S. L. Gogia.

APRIL 19

Institute of Fuel:—Annual luncheon at the Connaught Rooms, Great Queen Street, London, W.C.2, at 1 p.m. (reception 12.30 p.m.). Principal guest and speaker: Sir Julian Pode, managing director, Steel Company of Wales, Limited.

Institute of Marine Engineers (North Midlands Section):—Meeting at the School of Art, Green Lane, Derby, at 7.15 p.m. "Distillation for Marine Purposes," by Capt. W. R. Stewart.

Society of Instrument Technology (Newcastle Section):—Meeting at Roadway House, Oxford Street, Newcastle-upon-Tyne 1, at 7 p.m. "The Design, Application, and Selection of Automatic Control Valves," by P. Stone.

Institution of Chemical Engineers (North Western Branch):—Meeting at the Grosvenor Museum, Chester, at 7.30 p.m. "Some Corrosion Problems in the Chemical Industry," by D. Bennion.

Midland Counties Institution of Engineers:—Meeting at the Mines Rescue Station, Ashby-de-la-Zouch, at 3 p.m. "Fast Moving Faces," by F. Fairclough.

Institution of Production Engineers (Birmingham Section):—Meeting at the Midland Hotel, Birmingham, at 7 p.m. "International Competition in Machine-tool Design and Production," by R. Asquith.

Institution of Production Engineers (Peterborough Section):—Meeting at Peterscourt, Peterborough, at 7.30 p.m. Film evening.

Institution of Plant Engineers (Kent Branch):—Meeting at the King's Head Hotel, High Street, Rochester, at 7 p.m. "Plastic Bearings," by J. F. L. Ludgate.

APRIL 20

South Wales Institute of Engineers:—Meeting at Park Place, Cardiff, at 6 p.m. "Rope Attachments," by E. Ivor David.

Institution of Production Engineers:—Meeting at the Royal Commonwealth Society, Northumberland Avenue, London, W.C.2, at 7 p.m. "High-speed Cinematography in Production," by J. Hadland.

Institution of Plant Engineers (Blackburn Branch):—Meeting at the Castle Hotel, Blackburn, at 7.30 p.m. "The Application of New Materials to Plant Engineering," by J. Leyland.

Institution of Electrical Engineers (Utilization Section):—Meeting at Savoy Place, London, W.C.2, at 6 p.m. "Aluminium in Electrical Engineering," by P. J. H. Rata; "Diesel Railway Locomotives," by A. D. Swanston and B. W. Towell, and "Automatic Programming for Hot-reversing Mills," by T. E. S. Rickard.

APRIL 20—MAY 4

Engineering, Marine, Welding and Nuclear Energy Exhibition:—Olympia, London, W.14.

APRIL 21

Wigan and District Mining and Technical College (Past and Present Mining Students' Association):—Annual general meeting in the board room of the college at 5 p.m.

North East Coast Institution of Engineers and Shipbuilders:—Meeting at the Mining Institute, Newcastle-upon-Tyne, at 6.15 p.m. "The Pametrada Hydraulic Transmission," by Dr. T. W. F. Brown, P. H. Cleff, and T. A. Andvig.

Mineworkers' Boxing Championships:—Southern finals at the Gwyn Hall, Neath, at 7.30 p.m.

APRIL 24

Institution of Plant Engineers (West and East Yorkshire Branch):—Meeting at the Houldsworth School of Applied Science, Leeds University, at 7.30 p.m. "The Introduction of Planned Maintenance Systems," by A. F. Stedman.

APRIL 25

Society of Instrument Technology:—Meeting at Manson House, 26, Portland Place, London, W.1, at 7 p.m. "Instrumentation in the Iron and Steel Industry," by A. H. Pople.

Institution of Plant Engineers (South Wales Branch):—Meeting at the South Wales Institute of Engineers, Park Place, Cardiff, at 7.30 p.m. "Fuel Efficiency," by W. Short.

APRIL 26

Swansea College of Technology Mining Society:—Meeting at the college at 6.30 p.m. "Economics of the Coal Industry," by G. F. MacRobie, economic adviser, National Coal Board.

National Association of Colliery Managers

APRIL 17

Midland Branch:—Meeting at the Five Ways Hotel, Nottingham, at 6.30 p.m. "Health and Safety in 1960," by H. S. Stephenson, HM Divisional Inspector of Mines.

APRIL 21

Kent Branch:—Annual general meeting at the Swan Hotel, Deal, at 7.15 p.m., followed by "The Reconstruction of Snowdown Colliery," by J. L. Huxley, agent/manager, Snowdown Colliery.

APRIL 26

Lancashire Branch:—Meeting at 40, Portland Street, Manchester. "The Application of Fluid Drives in the Mining Industry," by E. C. Farrer, director, Fluidrive Engineering Company, Limited.

APRIL 27

South Staffordshire, Warwickshire, Worcestershire and Shropshire Branch:—Visit to Bretby Central Engineering Establishment.

APRIL 28

Kent Branch:—Annual dinner and dance at the County Hotel, Canterbury.

RECENT DEVELOPMENTS IN WELDING

SPRING meeting of the Institute of Welding will be held in London from April 25 to 28. Ten papers will be presented, the theme being "Recent Developments in the Welding and Allied Processes."

Recent developments in contact-type electrodes, the use of gas mixtures in gas-shielded bare wire welding, and automatic tungsten arc welding of heat exchangers will be discussed at the first session. The second session will be given up entirely to metal spraying and brazing. One paper deals with automatic controls of mechanized metal spraying equipment and another describes an adhesion test for aluminium spray-coatings and other metallized surfaces carried out at the National Gas Turbine Establishment.

The last meeting will be concerned with stud welding, a new German process called foil seam welding, and some work undertaken at the British Welding Research Association on the inert gas-shielded metal arc welding of thick copper without preheat.

IT IS REPORTED from Norway that Mo i Rana's pig-iron production last year increased to 312,000 tons, while crude steel production moved up to 340,000 tons. The corresponding 1959 production figures were 281,000 tons and 291,000 tons, respectively.

POWER-DRIVEN

Belt Jointing Machine

FOR UNDERGROUND USE

FOLLOWING the successful application of the power-operated conveyor belt jointing machine in central conveyor stores, Hayden-Nilos, Limited, Sheffield, has designed a similar machine, called the power Zipper, for underground use. Power is provided by a standard electrically driven or compressed-air operated rotary boring machine for both belt cutting and clamping the jointing hooks.

Designed for the maintenance of main or trunk conveyor belts, and weighing approximately 380 lb., the machine is able to accommodate belt widths up to 42 in. with a maximum thickness of $\frac{1}{4}$ in.

The conveyor belt is held in the machine by two spring-loaded clamps, the jaws being serrated for improved belt grip. True alignment of the belt with the machine is ensured by a fitted guide, which is adjustable for different belt widths.

The cutting blade is attached to a nut which is traversed along the full width of the belt by a leadscrew (Fig. 1). The leadscrew is rotated by a coal boring machine applied to a direct-on gearbox fitted with a reverse lever for cutting the conveyor belt in both directions. The leadscrew is driven through a spring-loaded dog clutch, so that when the blade has reached the end of its cutting run, the clutch slips, thus preventing further movement of the cutting blade in that direction.

After the machine has been loaded with the correct length of belt-fastening hooks for the width of belt being prepared, the previously squared off belt is again clamped in the machine for the final closing of the belt-fastening hooks. The boring machine is transferred from the belt cutting input shaft to the drive for the transport bar which drives the clamping head (Fig. 2). Each hook is closed separately and the clamping head is automatically traversed for the closure of the next hook.

The transport bar is driven through a 5 to 1 reduction gearbox and when the clamping head reaches the end of its travel, it enters an unthreaded portion of the transport bar, thus stopping the traversing motion.

To ensure that the correct clamping pressure is applied, a resetting device is fitted so that the clamping jaws are in position before the upper jaw is adjusted for different belt widths.

The clamping head slides between stainless-steel bars, one of which is graduated to ensure the central position of the belt in the machine. The jaw clamping mechanism can be disengaged to slide the clamping head back for the preparation of the next belt joint.

In order to minimize the effects of torque in the transport bar during the clamping operation, later

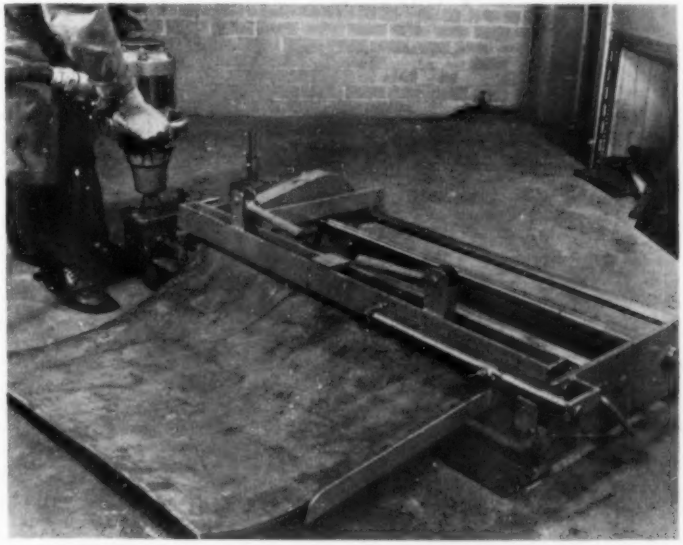


FIG. 1.—BELT BEING CUT SQUARE PRIOR TO THE PREPARATION OF THE BELT JOINT.

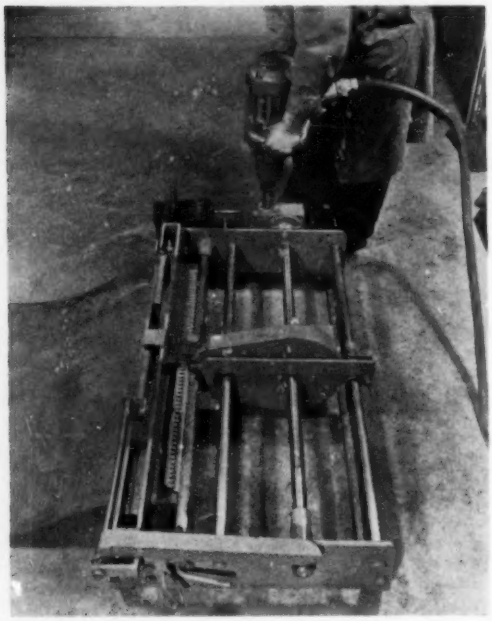


FIG. 2.—CLAMPING THE BELT-FASTENING HOOKS USING AN ELECTRICALLY DRIVEN BORING MACHINE.

models have been fitted with a 9-in. flywheel, keyed to the end of the bar opposite to the driven end.

The machine is able to cut a 36-in. belt in 12 sec., the jointing operation taking 1 min. 12 sec. During field trials of the prototype machine in South Wales it was found possible, under ideal conditions, to renew 36 belt joints in a 5½-hr. shift.

GUM STOWER DEFLECTOR

KEEPING the cutter chain of a gum stower free from gummings is the object of a deflector plate devised by Mr. B. P. Collins, a coal cutter at Pleasley Colliery.

Usually, the stower ejects coal gummings about 15 ft. into the waste. The deflector is devised to curb the length of throw to about 2 ft., so that the gummings are thrown on the face conveyor.

The deflector plate is movably mounted on a bracket by means of a pivot stud, which extends through a hole in the plate. The plate has two holes to accommodate bolts to which are secured the ends of two helical tension return springs. These are anchored at the other end to a clip. The bracket and clip fit on to the housing of the gum stower and are held in position by the springs. By stretching the springs the bracket and clip can be readily put in position on or removed from the housing. To clear obstructions the plate pivots on a stud and is returned to the operative position by one of the two springs.

West Notts Mining Students

A SYMPOSIUM was held for the diploma and advanced mining students at the West Nottinghamshire Technical College from March 20 to 22.

At the opening session, the chairman, Mr. R. Young, welcomed the students present, and introduced the first speaker, Mr. L. Stevenson, chief scientist of the No. 3 Area of the East Midlands Divisional Coal Board, who presented a paper on "The Work and Organization of an Area Scientific Department." Mr. Stevenson discussed the work carried out by the department, methods of analysis of gases and dust, number of samples analysed and the results obtained, with special reference to the detection of heatings in the mine.

The meeting was divided into three syndicates, after which the respective secretaries presented their reports. Questions were put to the speaker and a lively discussion followed.

In the afternoon, Dr. N. M. Potter, the carbonization general manager of the East Midlands Division, presented a paper entitled "Trends in the Processing of Coal."

The second day of the symposium was opened by the chairman, Mr. D. M. Hardy, who introduced the speaker, Mr. J. B. Halliwell, No. 4 Area sinking and tunnelling engineer. His lecture on "Shaft Sinking" was illustrated by two films on the sinking of Bevercotes Colliery, after which questions set by the speaker were discussed in syndicate.

During the afternoon of March 21, the speaker was Dr. H. Titman, chief scientific officer, Safety in Mines Research Establishment, Buxton, who spoke on "Fires and Explosions." The chairman was Mr. B. Mangles.

The third day was devoted to marketing. Mr. W. Johnson, who was introduced by Mr. J. H. H. Chamberlin, dealt with the preparation of coal for the market, including classification, properties, and the price structure.

The final paper of the symposium, entitled "Marketing of Coal" was presented by Mr. C. P. N. Choyce, deputy marketing manager, East Midlands Division. The chairman for this meeting was Mr. B. E. Hadfield.

Practical Training in Production Engineering

The Institution of Production Engineers is issuing to training officers in industry, to principals of technical colleges, and to others interested in apprentice training, copies of a new booklet entitled "Practical Training in Production Engineering." Adequate and appropriate practical training is one of the three essential requirements for membership of the institution. Although much has been done, and is being done, the greater interest now being shown in practical training, stimulated among other things, by sandwich courses, has indicated that the time is opportune for restating the basic principles essential for such training. Copies of the booklet may be obtained, free of charge, from the institution at 10, Chesterfield Street, London, W.1.

Details are given in this article of the method of construction of the second Blackwall tunnel by the shield method of drivage under high-pressure atmospheric conditions. The tunnel is being driven to deal with the heavy industrial traffic in east London and will operate in conjunction with the present one.

Tunnelling Under the Thames

Duplicate Drivage for Vehicular Traffic

by H. COOPER, A.M.I.Min.E.

(*Mining Editor*)

TRAFFIC problems have grown tremendously in Great Britain during the last 20 years and all road users are aware of the major construction work that is taking place to provide urgently needed improved roads and highways. Many cities are engaged in schemes to streamline the flow of traffic and London, where the concentration of traffic is perhaps the greatest, is no exception to the constructional work being undertaken.

Of special interest to mining engineers is the drivage of a second Blackwall tunnel under the eastern reaches of the Thames between Poplar and Greenwich. The tunnel, with a finished diameter of 28 ft., is being undertaken for the London County Council by Balfour Beatty & Company, Limited, with Mott, Hay & Anderson, London, S.W.1, as consultants.

Construction of the tunnel, which is taking place simultaneously at both the north and south shores of the river, is to be completed in two stages. The first stage has already been started; broadly, it comprises the sinking of access shafts, the drivage of two 7-ft. dia. pilot tunnels, the ground treatment with chemicals from the initial tunnels to secure and seal the strata before the drivage of the main tunnel.

During this time two caissons are being sunk on each side of the river to provide access for the necessary equipment for the main drivage and to form the ventilation shafts for the completed tunnel. The second phase of the work will be the drivage of the 28-ft. dia. cast-iron lined tunnel from both the north and south shores of the river.

Method of Drivage

The unconsolidated strata through which the tunnel is being driven consists of blue clay, Thames gravel, and the Woolwich and Reading Beds. The minimum cover from the top of the finished tunnel and the bed of the river will be approximately 20 ft. Obviously, large quantities of water could be expected and this, coupled with the nature of the strata, limited the choice of the method of drivage to be adopted. Shield drivage, which consists of forcing through the strata a wedge-shaped circular cutting edge by hydraulic power, was finally chosen as the best possible method for the drivage of both the main and pilot tunnels.

The pilot tunnels are supported by 2-ft. wide cast-iron tubbing sections, bolted together to form the finished diameter of 7 ft. The tubbing section forms the anchor from which the shield is advanced. Eight 6-in. dia. hydraulic rams, applying a total load of about 25 tons, force the shield forward. The previously set cast-iron sections are further supported by additional jacks spaced radially round the periphery of the tunnel. A sheet-steel lining follows immediately behind the cutting head to support the newly exposed ground until the face of the tunnel is loaded out and the permanent supports set.

Compressed-air clay spades are used to break down the face of the tunnel and the debris is hand-loaded into bogey-mounted skips. The skips are hauled to the temporary access shafts and the debris disposed of at a distant site.

When the 2-ft. advance has been completed, the pushing jacks are retracted and the next tubbing section erected. The radial jacks are then transferred to the newly erected section and the shield advanced a further 2 ft. Under normal conditions, a rate of 1 ft. per hour is maintained, giving a daily advance on three 8-hr. shifts of approximately 24 ft.

In addition to adopting shield drivage in the water-bearing strata, the tunnelling operation is carried out under high-pressure air. A pressure of between 28 and 30 lb./sq. in. is maintained in the tunnels to prevent the inlet of water. The pressure has to be accurately maintained for too much

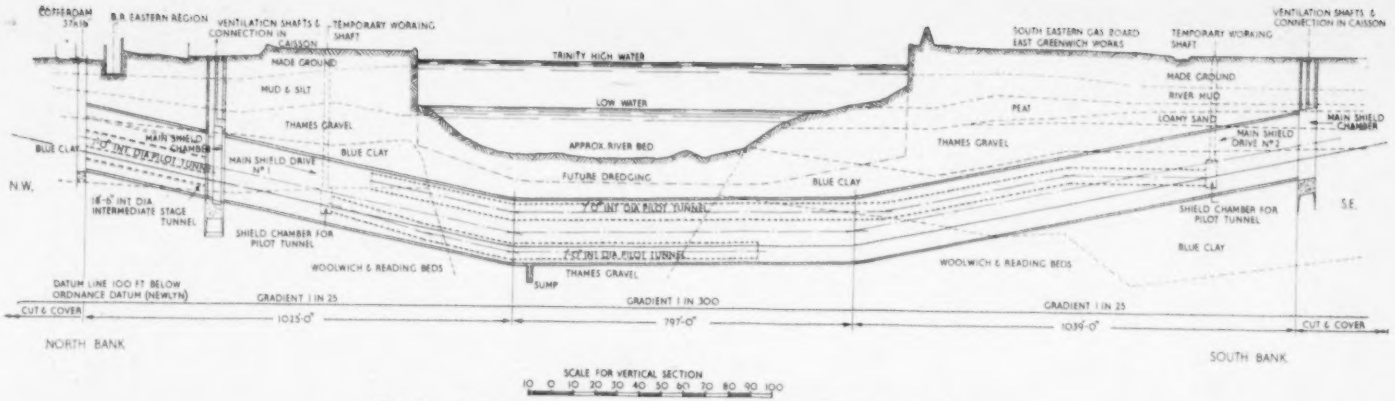


FIG. 1.—LONGITUDINAL SECTION THROUGH THE LINE OF THE TUNNEL.

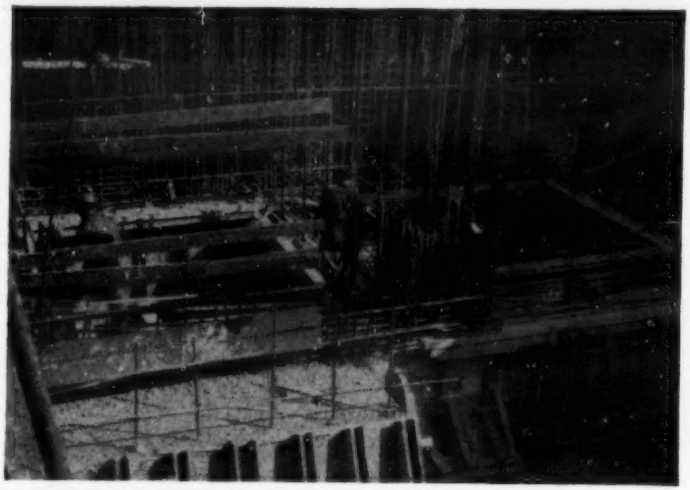


FIG. 2.—FOUNDATION OF THE AIR SHAFTS IN THE CAISSON AT THE NORTH BANK OF THE THAMES.

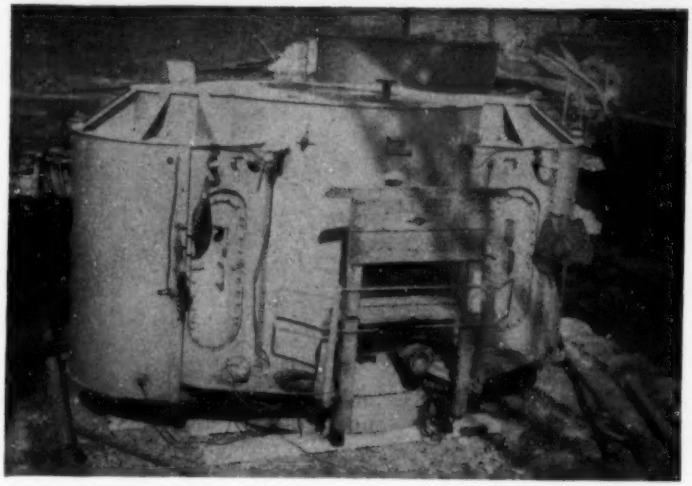


FIG. 3.—AIR LOCK TO MAINTAIN PRESSURE WITHIN THE DRIVAGES.

would cause an escape of air through the roof of the tunnel to the river bed and too little would obviously allow the water to enter the tunnel, which, owing to the head of water developed in the tunnel height, would first occur at the floor of the drivage.

This system of caisson drivage lends itself to the piping of water by the "snore" method, which consists of a pipe range fitted with a valve, laid from the tunnel face to atmosphere. When the valve is opened, water is forced to the surface by the difference in pressure. Pressure of the air in the tunnel is maintained by three Alley & Maclellan electrically driven compressors which each deliver 5,000 cu. ft./min. In the event of a power failure, five diesel-driven compressors, each delivering 1,000 cu. ft./min., provide the specified one third standby capacity.

A further aspect of caisson tunnelling is the reduced effect of the high-pressure compressed air for operating tools and machinery. Although the pressure is maintained at approximately 90 lb./sq. in., the effectiveness is reduced to approximately 60 lb./sq. in. by the pressure of the ambient air. This pressure of 60 lb./sq. in., however, is found to be sufficient to operate efficiently the tools and equipment at the face.

The two pilot drivages from the north and south banks of the river will not meet; the south drivage will pass vertically over the north pilot tunnel to provide duplicate tunnels immediately under the river where the more difficult gravel beds are expected. This arrangement will facilitate the drivage of the main tunnel, making it possible to maintain the scheduled rate of advance in the difficult strata.

Physiological Effects of High-pressure Air

When working in high-pressure atmospheres, men are subject to the dangers of suffering from "diver's bends." When the body is subjected to high pressures, nitrogen is absorbed by the tissues from the blood and unless return to normal pressure is slow enough for reabsorption of nitrogen to take place, bubbles of nitrogen are formed in the tissues of the body, causing pain in the limbs and abdomen. To allow the tunnellers to become readjusted to normal air pressure, they spend 40 to 50 min. in a decompression chamber supervized by a medical orderly who controls the rate of adjustment. In addition to the medical orderly a doctor is present on the site.

Fig. 1 shows a longitudinal section across the river bed on the line of the tunnel drivage. The major portion of the drivage is to take place under pressure between the two main shield chambers. Construction of the chambers, which will provide access for the extensive equipment necessary for the main shields is already being undertaken. They are being formed by the drop shaft method and when completed will each weigh 7,500 tons. When the chambers have been formed the main shields will be installed and drivage will commence after the completion of the pilot tunnels and the consolidation of the surrounding strata throughout the length of the tunnel by chemical treatment. During the construction of the main chambers, the air shafts for the final ventilation of the tunnel are being formed (Fig. 2). An air seal, shown in Fig. 3, will be fitted on the top of each caisson.

To gain the necessary depth of cover to tunnel under the river, the approaches are to be driven at gradients of 1 in 25 for a distance of 1,025 ft. for the northern section and 1,039 ft. for the southern section. Under the bed of the river a gradient of 1 in 300 for a distance of 797 ft. will be maintained for the drainage of water into the sump at the northern end of the tunnel.

The main shield drivage is to be undertaken by an extension of the system adopted for the pilot tunnels. The cutting blade, shaped at 45 deg., is thrust forward by 42 rams spaced round the periphery of the lining consisting of 18-in. wide cast-iron segments. The rams are supplied with oil at 2,000 lb./sq. in. by a compressed-air driven oil pump mounted within the structure of the shield. A maximum thrust of 6,000 tons, or 142 tons per ram, can be applied to force the cutting blade through the strata. Corrections in alignment are made by varying the pressure applied to different rams.

The shallow approaches to the tunnel, which are the responsibility of the LCC, will be formed by the cut and cover method. At the north shore a distance of 290 ft. is being driven in free air from a cofferdam marking the end of the open-cut construction. This free-air drivage, formed first by 7-ft. and then 18-ft. 6-in. dia. pilot drivages, is considered necessary since the depth of cover is not great enough to withstand the pressure exerted from within the tunnel.

At the south end of the tunnel, the approaches will be made by cut and cover formation up to the main shield chamber.

Work on the drivage of the southern pilot tunnel started at the end of November, 1960, and approximately 1,000 ft. of drivage has been completed. Drivage of the northern pilot tunnel started recently and only 32 ft. of tunnel has been completed.

Acknowledgment is made to the London County Council for permission to visit the site and to Mr. G. P. Coleman, site engineer, and Mr. P. Gough, assistant site engineer, for Mott, Hay & Anderson, for their help and co-operation.

Indian Colliery Managers

INDIAN branch of the National Association of Colliery Managers held its big social event of the year—the annual dinner and dance—on March 11. The chief guest was Mr. R. C. Dutt, managing director of NCDC.

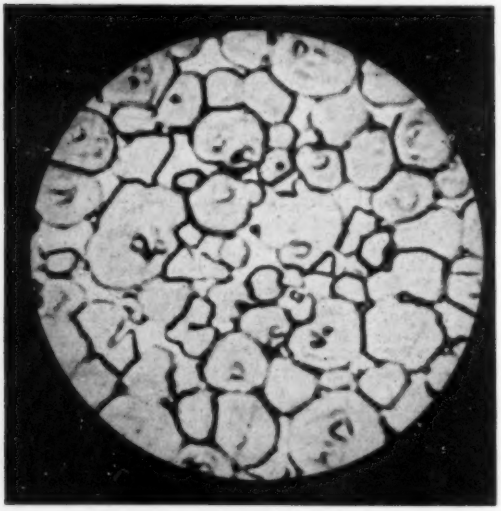
On March 4, branch members had an enjoyable and instructive excursion to the Jamshedpur plant of the Tata Iron & Steel Company, Limited.

THEME OF the 13th British Electrical Power Convention, to be held at Eastbourne from June 12 to 15, will be "Electricity in the Prosperity and Welfare of the Nation."

New Tungsten Carbide Grade

UNUSUAL structure and distinguished properties are embodied in a new tungsten carbide grade developed by the Sandvik Steelworks Company, Limited, Sweden. Known as S1 Premium, this grade is now patented in Great Britain and marks another progressive step in tungsten carbide technology. Because of its remarkable wear resistance, S1 Premium has special merits when machining steel and steel castings, and no less than 30 to 40 per cent. more pieces per cutting edge can normally be expected when using this new grade.

A tungsten carbide tipped tool used for machining steels will only have a long life, if, besides sufficient abrasion resistance, it also possesses a



THE ILLUSTRATION SHOWS THE STRUCTURE MAGNIFIED 1,200 TIMES.

high resistance to cratering. The degree of crater resistance is mainly dependent on the amount of titanium and tantalum carbides. The percentage of tantalum carbides present is usually very small. S1 Premium has a high content of both titanium and tantalum carbides, and is characterized by a particularly high degree of wear resistance, both in respect of cratering and abrasion. Furthermore, the combination of the binding medium cobalt, and the special structure of S1 Premium is such, as to give this grade a degree of toughness exceeding by far the average for this group of carbide grades.

Tips, inserts, turning tools, shell-end mills, cutter blades, etc., in S1 Premium can be obtained from Sandvik Swedish Steels, Limited, Halesowen, Birmingham.

Liberian Iron-ore Deposits

DEVELOPMENT of iron-ore deposits in the Nimba Range, Liberia, have been assured by the announcement by the Export-Import Bank of Washington of the authorization of a $30,000,000 credit to Lamco, the Liberian American-Swedish Minerals Company, thus completing the financing of the "Lamco Joint Venture."

Swedish companies are to contribute about $50,000,000 towards financing the exploitation of these deposits, estimated, as far as is now known, at more than 200,000,000 tons of ore, with an average content of 65 per cent. Fe. Operations are scheduled to start in the first half of 1963, at the rate of 5,000,000 to 6,000,000 tons a year, which will be increased later to 10,000,000 tons.

The Nimba project, including a 165-mile railway to the port of Buchanan, is owned by Lamco and Bethlehem Steel Corporation, Lamco holding three quarters, and Bethlehem one quarter of the interests. In Lamco, half of the shares are held by the Liberian Government, and the other half by Liberian Iron Ore, Limited (LIO), of which the majority are owned by the Swedish Lamco syndicate and the balance by private interests in the United States and Liberia, including the International African American Corporation, of Delaware.

In the Swedish syndicate, three sevenths are owned by the Grängesberg Company, two sevenths by Atlas Copco and Nordströms Linbanor, and two sevenths by Skänska Cement, Ifoverken, and Sentab. This syndicate has already contributed $28,000,000 of the $11,500,000 in shares and $38,000,900 in debentures, which it is to invest in the project.

The entire scheme will call for investments within the range of $200,000,000. Of this amount, the Bethlehem Steel Corporation will contribute $50,000,000. Apart from the Export-Import Bank loan, the German Kreditanstalt für Wiederaufbau has granted $50,000,000, and the First National City Bank of New York, $5,700,000. Most of the bank credits granted will be used for financing deliveries of equipment from the United States and western Germany.

Under a management agreement between Lamco and Bethlehem Steel Corporation, the Grängesberg Company is to handle the construction of the plant, the mining operations, and the transport of the ore to Buchanan. Bethlehem Steel Corporation is to take about a quarter of the output, while most of the remaining quantities has been placed on long-term contracts, principally with German steelworks. Sales of Lamco's proportion of the ore output will be handled by Malmexport, the joint sales company of Grängesberg and the Swedish LKAB mining company. Units of the Grängesberg fleet of ore carriers will be available for transporting the ore.

Metallurgical Patents in the US

Some Recent Inventions

DESCRIPTIONS of metallurgical patents given below have been taken from details published in the Official Gazette of the United States Patent Office.

Guide Chute for Hot-strip Coilers

A guide chute for hot-strip coilers comprises a pair of strip entry guides arranged in converging angular positions relative to the direction of strip movement. Pivot support is provided at the outer ends of the guides to allow adjustment of their respective angular positions. A pair of parallel guides is arranged inwardly of the entry guides mounted in laterally spaced relation for guiding engagement with opposite edges of the strip, and means for adjusting the lateral spacing of the parallel guides according to the width of the strip to be guided thereby. The inner ends of each of the entry guides are hinged with one of the parallel guides for adjusting their angular positions in response to change in the lateral spacing of the parallel guides, while means independent of the adjusting means provide for moving at least one of the parallel guides laterally between an operative strip guiding position and an inoperative retracted position.—2,965,209.

Roll Structure

A roll comprising a cylindrical metal core and a cast bimetallic tubular shell shrink-fitted on the core, the shell comprising an outer layer of a hard, abrasion-resistant metal having a Brinell hardness value of at least about 400 and an inner layer of a metal the ductility of which is not materially affected by heat treatment, the two layers being united throughout their contiguous surfaces by a metallurgical bond formed during the casting of the shell by intermixing of the two metals at the contiguous surfaces.—2,964,251.

Method of and Apparatus for Extruding Tubing

Apparatus for extruding metal tubing comprises a tube die housing, a tube die member, and a core constructed and arranged so as to be axially immovable during an extruding operation. A coalescence chamber is adjacent the die member, a transversely extending fixed part of the housing being provided with a passage through which metal in a solid state is supplied to the chamber for extrusion therefrom. An unobstructed cylinder communicating with the passage and otherwise separated from the chamber by the extending fixed part, is adapted to hold a solid billet of metal to be extruded, means, independent of the core, and including a piston which extends completely across the cylinder, being operable for forcing the metal of a solid billet in the cylinder, to flow through the passage into the chamber and to coalesce around the core and to be extruded as metal tubing from the chamber. The tube die is provided with a die opening communicating with the coalescence chamber for determining the outside of the tubing as it is extruded from the chamber. The transversely extending fixed part of the housing has a socket, one end of the core being loosely received in the socket so that the one end of the said core is loosely supported and centred by the housing, the other end being free and projecting through the chamber freely into the die opening for determining the inside of the tubing as it is extruded from the chamber.

The supporting arrangement between the one end of the core and the housing is such that the core is free to float transversely relative to the die member. The core during extrusion is engaged by the metal in the chamber, the free end of the core being otherwise unrestrained against limited movement transversely of the chamber except by the metal therein so that pressure on the free end of the core acts to centre it during an extruding operation relative to a predetermined axis passing through the die opening.—2,964,178.

Continuous Extrusion

In an extrusion press a container has two billet receiving chambers disposed in coextensive end to end relation and having different cross sectional areas. A first ram is slidably mounted at the outer end of one of the chambers, a second ram being opposed to and substantially coaxially disposed with respect to the first ram and extending through the other chamber, the second ram being adapted to move into and out of sliding engagement with the walls defining the other end of the first chamber. An extrusion die is operatively mounted on one of the two rams, the latter ram being hollow to allow the extruded product to pass therethrough, and a third ram mounted for movement into and out of sliding engagement with the walls defining the other chamber and being substantially concentric over and slidably disposed with respect to the second ram, the three individual rams being movable in predetermined timed relation so that respective chambers are alternately communicated with and isolated from each other by the second ram, an extrusion force being continually applied to the work material in one chamber by at least one of the three rams.—2,964,177.

Non-ridging Stainless Steels

A non-ridging ferritic stainless steel consisting essentially, by weight, of about 14 to 25 per cent. of chromium, up to about 0.60 per cent. of carbon, up to about 1.25 per cent. of manganese, a maximum of 1 per cent. of silicon, a small amount that is less than 1 per cent. of columbium effective to characterize the resulting product with non-ridging characteristics upon being drawn, and the remainder iron and incidental impurities.—2,965,479.

Magnetomotive Agitator for Molten Metal Baths or the Like

In a magnetomotive stirrer for fluent substances, apparatus comprises, in combination, an inductor having a rotor and a stator class of members, means for impressing alternating current excitation upon one of the class of members to provide an alternating output in the other thereof, the stator class of members being angularly spaced, means providing for rotating the rotor class of members to provide a predetermined frequency and magnitude of impulses in the output.

Provision is made for converting the alternating impulses into unidirectional impulses of the frequency, while means provide for impressing the unidirectional impulses upon a means of amplification to magnify the impulses which are transmitted to spaced magnetic coil and core members to provide a succession of temporarily and spatially spaced unidirectional magnetic flux forces to stir the fluent substances.—2,964,581.

Charging Devices for Shaft Furnaces

A charging device for shaft furnaces, comprises a lower stationary hopper, an upper rotatable hopper, an upper rotatable bell adapted to partake in the rotation of the upper rotatable hopper and adapted to be moved vertically between an upper position in which it closes the bottom opening of the upper bell and a lower position in which it opens the opening to permit dumping of stock from the upper hopper to the lower hopper. A lower non-rotatable bell is disposed below the upper feed opening of the lower hopper, and has a greater diameter than the feed opening, this lower bell being adapted to be vertically moved between an upper position in which it engages sealingly the edge of the feed opening of the lower hopper to prevent leakage of gas therefrom and a lower position in which it opens the feed opening to permit dumping stock into the lower hopper, the upper rotatable bell having a smaller diameter than the feed opening of the lower hopper so that it can pass through it.—2,965,249.

Method of Cleaning Iron-ore Fines, Notably for the Manufacture of Improved Ferrous Coke

A method of cleaning iron-ore fines, such as blast-furnace dust, prior to their subsequent utilization for the manufacture of ferrous coke, consists of roasting the iron ore fines in the absence of circulating air under the action of the sensible heat of at least 800 deg. C. of incandescent coke in contacting relationship therewith, in order to decarburize and at least partially reduce the fines, and subsequently washing the treated fines with water in order to substantially eliminate the deads from the fines.—2,965,473.

Austenitic Steel Alloy

An alloy steel consisting of 0.8 to 1.5 per cent. carbon, 5.0 to 9.0 per cent. manganese, 2.0 to 5.0 per cent. chromium, 0.05 to 0.15 per cent. aluminium, and the remainder essentially iron.—2,965,478.

Method of Heat Treating Silicon Steel

A method of producing oriented silicon steel comprises cold rolling a hot-rolled silicon steel strip of a thickness of about 0.075 to 0.120 in. having a composition consisting essentially, by weight, of about 2.2 to 5.25 per cent. Si; 0.001 to 0.05 per cent. of at least one material of the group consisting of metal oxides, metal sulphides and metal nitrides, a maximum of about 0.02 per cent. of C, and the remainder iron, to reduce the strip about 60 to 80 per cent., heating the cold rolled strip at a rate of from 1,600 to 2,000 deg. C./min. to a temperature of from 850 to 1,050 deg. C. and maintaining it at the temperature for a time sufficient to effect recrystallization, cold rolling the thus heat-treated strip to effect a further reduction of from 50 to 60 per cent., based on the then thickness, and again heating the strip at a rate of from 1,600 to 2,000 deg. C./min. to a temperature of at least about 850 deg. C. and maintaining that temperature for a period of time just sufficient to soften the material, then subjecting the strip to a high-temperature anneal for a period of from 1 to 8 hr. at a temperature of from 1,000 to 1,300 deg. C., this temperature being attained by heating at a rate of from 2 to 15 deg. C./min., each of the anneals being conducted in a non-oxidizing atmosphere and subjecting the strip to a decarburizing anneal at a temperature not exceeding 800 deg. C. in wet hydrogen, the order of precedence of the high temperature final anneal and the decarburization anneal being immaterial.—2,965,526.

Sheet Slitting and Scrap Coiling Machine and Method

In a machine of the class described, means provide for advancing a sheet along a predetermined path, sheet slitting means being stationarily mounted adjacent the path and operative to progressively slit the sheet on a line parallel with the line of feed and near one edge of the sheet, thereby progressively forming a scrap strip from the portion of the sheet between the edge and the slit. A scrap strip coiling device stationarily mounted adjacent the path of travel receives the scrap strip as it is progressively formed. The coiling device has means for progressively coiling the scrap strip helically about an axis, whereby the strip will have the form of a substantially cylindrical coil upon final severance from the sheet. The slitting means comprises an upper and a lower disc in overlapped relation with each other, the coiling device being disposed in the angle between one side of one of the discs and the periphery of the other of the discs. The coiling device has a notch to progressively receive and coil the scrap strip and also a tapered lip at one side of the notch, the lip being substantially in contact with disc periphery to guide the scrap strip into the notch.—2,969,103.

Treatment of Ferrous Metal

A process for the treatment of molten ferrous metal allows it in subdivided form to fall freely through a reaction space in contact with a stream of oxidizing gas fed to the reaction space. For reducing the escape of fume from the reaction space, the injector action of the oxidizing gas fed to the space is to withdraw at least a part of the fume from the reaction space at a point remote from that at which the oxidizing gas is fed to the space and to return the withdrawn fume to the reaction space entrained in the oxidizing gas.—2,969,282.

Gravity Concentrator for Metallurgical Materials

A gravity concentrator, comprising an elongate deck structure defining a flat and smooth deck surface arranged for traversal, longitudinally, by liquid pulp containing solids to be concentrated, the deck surface having a feed end and a discharge end and sloping downwardly from feed end to the discharge end so that the liquid pulp will flow thereover under the influence of gravity. Means define a longitudinal series of mutually spaced, transversely extending, attenuate, slit openings at the deck surface and extending through the deck structure, each of the slit openings having width at the deck surface within the range of approximately 0.003 to approximately 0.015 of an inch and having effectively increased width along its depth to prevent plugging. The slit openings are adapted to bleed off fine solid particles of high specific gravity that tend to descend to and hug the deck surface, the deck structure being largely imperforated and free of obstructions so as to support and permit the unbroken flow thereover of the bulk of pulp. The thickness of the deck structure is considerably less than the distance between successive slit openings; and the

means below the deck structure for catching the concentrate bled off.—2,969,147.

Carbon Electrode Joint

A connecting joint between sections of an electric furnace electrode, comprises electrode sections, and a nipple threaded into a socket in each section holding abutting faces of the sections in contact. An improvement comprises at least one carbon rod inserted transversely in a portion of the nipple in each socket, the axial coefficient of thermal expansion of the rods being substantially higher than the transverse coefficient of thermal expansion of the nipple.—2,969,251.

Blower or Compressor of the Multi-cell Construction

A rotary blower comprises a cylinder having a peripheral wall and end walls, the peripheral wall being formed with inlet and outlet openings at opposite sides and the end walls. The blower is provided with aligned bearings on an axis eccentric to the axis of the peripheral wall, an annular recess being provided in the inner face of the wall near each end. A bearing ring floats in each recess with its inner face co-planar with the inner face of the peripheral wall of the cylinder.

A rotor extends between the opposite end walls, a plurality of equally spaced radial grooves being provided in the rotor extending from end to end, each radial groove running through a radial hole near each end. A vane slidably mounted in each radial groove has a transverse cylindrical formation near each end to fill the respective radial hole, the cylindrical formations having their outer extremities bearing on the inner face of that bearing ring which is at the same end of the cylinder. The vanes define pumping chambers between them as the rotor moves them past the inlet and outlet openings with the outer face of the rotor osculating the inner face of the peripheral wall, the outer extremities of the cylindrical formations on the vanes extending above the outer edges of the vanes. —2,969,171.

Reel Segment Guiding Arrangement

An expansible rotatable drum for handling coiled strip material, includes a plurality of segments having surfaces which together define a substantially cylindrical outer contour of the drum, the segments being disposed generally parallel to the axis of the drum A member rotatable coaxially with the drum but fixed against movement axially of the drum, and means for selectively moving the segments relative to the rotatable member radially away from the axis of the drum engage and hold a coil of strip material on the drum from within the coil. An improvement comprises elements interconnecting the rotatable member and an end of each segment adjacent an end of the drum, the outer contour of each element being convex and coincident with a substantial portion of the surface of a sphere. One of the rotatable members and an end of each segment adjacent an end of the drum have recesses therein extending radially of the axis of the drum.

The sidewalls of each recess enclosing the centroid of a particular element is of uniform cross-sectional configuration in a plurality of spaced planes parallel to each other and to the axis of the drum, the other rotatable member and the end of each segment adjacent an end of the drum having elements which co-operate with the recesses to provide a slidable and universally rotatable bearing connection between the rotatable member and the segments.—2,969,202.

MERL RESEARCH ON COLD EXTRUSION OF STEEL

GUDGEON pins and gears, sparking-plug bodies, hydraulic cylinders, ball races, and many other steel components are produced in the USA and Germany by cold extrusion. There has, however, been little industrial use of this process in Britain in spite of its ability to provide a high production rate, a product with a good surface finish and close dimensional tolerances, and greatly improved mechanical properties arising from cold working of the metal. In addition, the process may reduce or eliminate machining operations in the production of many types of component; this would result in a substantial saving in material—sometimes as much as 90 per cent.

Although simple cylindrical components can often be produced by a single operation, most engineering components require several stages such as forward extrusion, backward extrusion, upsetting and drawing, either in sequence or simultanously. The process will be economical for complicated shapes only if large numbers are required. As a result of detailed experimental investigations, information is now available from the Mechanical Engineering Research Laboratory, East Kilbride, Glasgow, to help in the selection of the best extrusion conditions for each operation and in the design of the appropriate tooling.

Extensive tests on the extrusion of the three basic forms (rods, tubes, and cans) have shown that steels containing up to 1 per cent. carbon and some low-alloy steels can be extruded satisfactorily; the reduction obtainable in these materials was found to be limited only by the permissible stresses in the tooling. It was also found that increase in ram speed from 2 to 16 in./sec. had little effect on the press load or properties of the product, and also that the usual phosphate coating on the billet was as effective in promoting good lubrication as a heavier coating.

The improved mechanical properties resulting from cold working are particularly important when the component is to be used without heat treatment following extrusion. Plain carbon steels hardened proportionately more than the alloy steels; for example, the hardness of mild steel, initially of about 100 HV30, was more than doubled at an extrusion ratio of 6.

Further information is given in NEL Plasticity Report No. 163 ("The Extrusion of Metals—Part VIII. Steel Under Cold Impact Conditions," by J. McKenzie and A. R. Rodger) available from the laboratory, which will also be pleased to advise on the extrusion of particular components. The latest information is given in: "An Experimental Investigation into the Cold Extrusion of Steel." by H. Ll. D. Pugh, M. T. Watkins, and J. McKenzie, which is published in the April issue of *Sheet Metal Industries*.

MINE MANAGERS AND OFFICIALS

A DRAFT of the Coal and Other Mines (Managers and Officials) (Variation) Regulations, 1961, has been circulated by the Ministry of Power. The Regulations, which the Minister of Power proposes to make under the Mines and Quarries Act, 1954, vary the Coal and Other Mines (Managers and Officials) Regulations, 1956, in two respects.

A new Regulation 6A is introduced into Part II (relating to the duties of managers and under-managers) which places a duty on under-managers to read forthwith statutory reports, records, or other items of information, which relate to a part of the mine within their jurisdiction, or to secure that they are read forthwith by some other competent person and that there is promptly brought to their notice any matter requiring their attention.

In Regulation 26 (which prescribes the qualifications required by a deputy) there is substituted for Para. (2) a new paragraph which provides that before a person is qualified to be appointed, or to be, a deputy he must within the last preceding five years have obtained a certificate that he was then able to make proper tests for inflammable gas. Regulation 3 provides that persons who would have been qualified to be appointed, or to be, a deputy but for the substitution shall be deemed to have the necessary qualifications.

It is proposed to bring the Regulations into operation on June 1, 1961.

Studies of Lateral Stone-dust Barriers

TESTS with lateral stone-dust barriers which do not take up the full width of a mine roadway, are described by Dr. W. B. Cybulski in the February issue of Revue de l'Industrie Minerale. The new barriers are placed along the sides of mine roadways, allowing unimpeded travelling for miners.

The aim of the tests is to examine the possibilities of arresting coal-dust explosions with the new type of barrier. General results with lateral barriers show that they can be used successfully in roadways of restricted height where the standard barriers cannot be installed. It is emphasized, however, that the lateral barriers must only be applied if the normal cross-width barriers cannot be installed.

The length of the platforms must be as great as possible and never less than half the width of the roadway if the units are disposed on only one side. In roadways of small cross-section the use of vertical stays should be avoided and the barriers should not be installed in roadways if the width is under 8 ft.

The stone-dust barrier zone must be completely stone dusted in such a way that the zone contains 80 per cent. of incombustible matter.

Mining Explosives Regulations

SCHEDULED to come into operation on June 1, the Coal Mines (Explosives) Regulations, 1961, have been circulated by the Ministry of Power in draft form. They replace, with amendments, the Coal Mines (Explosives) Regulations, 1956, and relate to the storage, issue, conveyance, and use of explosives and detonators, and to the appointment, qualifications, equipment, and duties of shotfirers at mines.

The principal changes from the provisions of the 1956 Regulations relate to the use of approved types of detonators, the qualifications required for firing shots, the care of explosives below ground, the firing of rounds of more than six shots, the pulsed infusion method of firing, the priming of rounds in cross-measure drifts, the use of delay detonators, restriction on shots in certain parts of mines, the stemming of shotholes in certain parts of mines, the re-entry of workmen into staple pits after shotfiring, and remedial action in the event of a miss-fire.

Exemptions, approvals, authorities, etc., granted for the purposes of the Coal Mines (Explosives) Regulations, 1956, are saved; and all special Regulations varying the application of those Regulations in relation to particular mines have effect as if they referred to the corresponding provisions of the amended Regulations.

FRICTIONAL SPARKING FROM ALUMINIUM ALLOYS

EXPERIMENTS made to determine how far the aluminium content of an alloy must be replaced by inert elements in order to reduce to an acceptable level the incendivity of the type of sparking caused by the oblique impact of aluminium alloys on rusted steel are described in SMRE Research Report No. 192, by Dr. D. Rae and Dr. B. J. Nield. The effect on incendivity of the hardness and heat-treated condition of the alloys is also examined.

The ignition hazard is shown to be greater with harder alloys for a given composition and impact conditions, but decreases with reduction in aluminium content. With moderately hard alloys, gas ignitions are obtained even when only half the atoms are aluminium, and it is considered that the hazard has been reduced to a tolerable level only when the aluminium content has been reduced to one third atomic proportion. The resulting alloys have a much greater relative density than aluminium and rather inferior mechanical properties, thereby forfeiting the original advantages of light alloys.

THE NETHERLANDS COMPANY, Verenigde Machinefabrieken (VMF), is to invest in a new Argentine company to produce diesel engines. A group of Argentine firms will contribute to the capital of the new company.

New Literature

COPIES of the house magazines, catalogues, and other publications referred to below are available to our readers. Application should be made to the address given, at the same time mentioning IRON AND COAL.

MORGANITE CRUCIBLE, LIMITED, Norton Works, Woodbury Lane, Norton (Worcs)—Leaflet AE.72 is a new publication dealing with crucibles, furnaces, and foundry accessories.

THE ENGINEERING CENTRE, Stephenson Place, Birmingham 2—Publication of the March issue of News Letter was delayed to enable a report to be included of the Leipzig Spring Fair.

BRITISH TIMKEN, Duston (Northants)—The March issue of Timken contains a report of a recent trade exhibition held at Worksop and much other news of the British Timken Division of the Timken Roller Bearing Company.

CRODA, LIMITED, Cowick Hall, Snaith, Goole (Yorks)—Two new technical data sheets are now available. One deals with "Prevok" general-purpose rust preventive and the other with anti-corrosive and other protective materials.

JOHNSON, MATTHEY & COMPANY, LIMITED, 78, Hatton Garden, London, E.C.1—The April number of Platinum Metals Review, a quarterly survey of research on the platinum metals and of developments in their applications in industry, has been published.

PYRENE COMPANY, LIMITED, Great West Road, Brentford (Middx)—The April-May issue of the Bonderizer, published by the company's metal finishing division, is a special GKN issue. The GKN group consists of over 80 companies in the UK and abroad and employs more than 75,000 people.

EDGAR ALLEN & COMPANY, LIMITED, Imperial Steel Works, Sheffield 9—Fully to appreciate the value of the Edgar Allen News one needs to be a regular subscriber (annual subscription 10s.), as most of the articles are of considerable length and are therefore continued month by month. The April issue is now available.

BRIGHTSIDE ENGINEERING HOLDINGS, LIMITED, Ecclesfield, near Sheffield—The spring issue of the Brightside News, the house journal of the Brightside group of companies, covers in a very readable manner the widespread activities of the group. In addition, room is found for a number of articles of general interest.

CRAVEN BROS. (MANCHESTER), LIMITED, Vauxhall Works, Reddish, Stockport—Continued expansion in steelworks' capacity has called for many more machine tools of the type in which the company specializes. A 65-in. roll grinder is among the items of equipment described in the March-April issue of the Craven Machine Tool Gazette.

G.W.B. FURNACES, LIMITED, Dibdale Works, Dudley (Worcs)—An attractive, indeed elaborate, brochure dealing with electric melting furnaces has been issued. The introduction traces the development of "Lectromelt" furnaces from their earliest days nearly half a century ago. Once acquired, this splendid publication will not be lightly cast aside.

WILD-BARFIELD ELECTRIC FURNACES, LIMITED, Elecfurn Works, Otterspool Way, Watford By-pass, Watford (Herts)—The Wild-Barfield Heat-Treatment Journal is also the technical journal of G.W.B. Furnaces, Limited, Dudley (Worcs), and the Applied Heat Company, Limited, Watford. The March issue contains a variety of interesting articles.

J. BROCKHOUSE & COMPANY, LIMITED, 25, Hanover Square, London, W.1—An article describing some of the factors involved in the production of plastics components by the injection moulding process is a feature of the April/June issue of the Forge. Other articles and news of developments within the organization at home and oversea are also included.

MORGAN REFRACTORIES, LIMITED, Neston, Wirral (Ches)—The company has issued a revised version of its leaflet on M.R. "Trumul" (RD.59/61). M.R. "Trumul" can be used with safety in ordinary furnace walls with hot face temperatures as high as 1,760 deg. C. Where heavy loading is encountered, as in piers, the limiting temperature would be somewhat lower.

PRESSED STEEL COMPANY, LIMITED, Cowley, Oxford—The front page of the April issue of Press Express, issued at "a turning-point of the year for Pressed Steel sports and social activities," is very largely devoted to a review of the company's widespread activities in this field. Works safety measures figure prominently in the remainder of this bright and lively works newspaper.

VICKERS, LIMITED, Vickers House, Broadway, London, S.W.1—A very useful 28-page booklet has just been issued outlining the products of the Vickers group. The products are arranged alphabetically and beside each one is a symbol indicating from which company (or companies) in the group the item may be obtained. Identification of symbols is shown at the foot of each page to facilitate easy reference.

RICHARD THOMAS & BALDWINS, LIMITED, 82, Brook Street, London, W.1—"A child brought up in a steel town such as Scunthorpe finds no difficulty in understanding that after he has been tucked up safely in bed for the night, his father is going to sit down to 'breakfast,'" says James Gray in "A Steeltown Never Sleeps" in the March issue of Ingot News. He emphasizes that iron and steel can have no respect for hours.

INSTITUTION OF WORKS MANAGERS, 196, Shaftesbury Avenue, London, W.C.2—"Films Can Help Where Verbal Argument Fails" is the title of an article in the April number of Works Management (2s. 6d.). The place of the cinema screen in industry has long been recognized, but this article is worthy of note by those concerned with works management. "Preventive Maintenance of Modern Boiler Plant" is among other features of this issue.

CARBORUNDUM COMPANY, Niagara Falls, New York, USA—The company has issued an eight-page colour brochure on "Fiberfrax." "Fiberfrax" alumina-silica fibres are a new class of high-temperature insulating materials that are lightweight yet physically strong. With their low thermal conductivity, these fibres will withstand continuous use at temperatures up to 2,300 deg. F. The brochure reviews a few of the many industrial applications of "Fiberfrax."

ATLAS COPCO (GREAT BRITAIN), LIMITED, Maylands Avenue, Hemel Hempstead (Herts)—"The Swedish Ladder Drilling Method" is among the interesting articles in the latest edition of Compressed Air Comments (Vol. 4, No. 1). Originally introduced by one of Sweden's leading contracting companies, the method has been developed by the company and by the

Swedish State Power Board to the stage where it is now being used with spectacular success.

J. H. FENNER & COMPANY, LIMITED, Marfleet, Hull—This is the company's centenary year. A note on the subject in the April issue of the V-Belt Journal states: "The next 10 years are of more concern to us than the last 100 years, but there are occasions when a look over the shoulder is permissible." This brief note on the company's history gives a clear picture of the large-scale developments down the years. The magazine gives an equally clear picture of the company's activities as the second century is embarked upon.

JAMES DOUGALL & SONS, LIMITED, Bonnyside Firebrick Works, Bonnybridge, Scotland—A booklet describing the silicon carbide refractories manufactured by the company under the trade name of "Sicardo" is now available. This refractory product is supplied principally for use in industrial kilns, furnaces, and boilers where, in certain positions, "the unique properties of 'Sicardo' can offer material advantages over all other types of refractories." Separate booklets describing the "Dougall" and "Docken" range of fireclay refractories, the "Aludo" range of high alumina refractories, and the range of refractory cements, mouldables, and castables are also available.

CLIMAX MOLYBDENUM COMPANY OF EUROPE, LIMITED, 2, Cavendish Place, London, W.1—Much useful information to metallurgists is contained in an attractive brochure entitled "Three Keys to Satisfaction." It is a guide to combining sound design principles, proper selection of steels, and good treatment to achieve optimum economy and material performance with special reference to molybdenum steels. The publication covers mainly heat-treated alloy varieties of tensile strength below about 90 ton/sq. in. and excludes steels such as the high-strength low-alloy structural, stainless, or tool steels. Nor does it cover the many types of molybdenum steels used primarily for operation at elevated temperatures, as in steam plants and gas turbines. Treatment includes:—Cold shearing; annealing; cold heading; machining; through hardening, and carburizing. Flame and induction hardening are dealt with, as is controlled cold working of finished parts. Welding also receives attention.

Arms of Japan's "Big Six" Steel Companies

NEW study of production plans of Japan's "Big Six" steel companies reveals that they expect to double their present output in the next five years. Last year, Japan exceeded French steel production by 6,000,000 metric tons and nearly equalled that of the UK. The "Big Six" produce 92 per cent. of Japan's pig-iron and 68 per cent. of her crude steel. A report prepared by the Fuji Bank indicates that they will achieve the Ikeda Government's 10-year plan for production of 48,000,000 tons of crude steel annually by 1970—five years ahead of schedule. If this production target is achieved, however, it is somewhat doubtful that demand will expand rapidly enough to catch up with such rapid growth, thus posing new problems, the report states.

Principal factors favouring continued expansion of the Japanese steel industry are the low *per capita* steel consumption rates, lack of competition in Japan's main export market of south-east Asia, and the immense potential market of mainland China. Japan's producers hope to raise domestic consumption by 1970 or earlier to present US figures of 960 lb. per person.

Computers in the Iron and Steel Industry

MAIN technical sessions at the Iron and Steel Institute's annual general meeting this year will be devoted to the use of computers in the iron and steel industry. Two new steelmaking processes—the Brymbo oxygen-electric process and the VLN process of the Steel Company of Wales, Limited—will also be discussed.

This year's meeting, on May 3 and 4, will be held at the Institution of Mechanical Engineers, London, S.W.1. The formal business of the meeting will be followed on the morning of May 3 by the induction of the new president, Sir Charles Goodeve, FRS (director of the British Iron and Steel Research Association), who will deliver his presidential address. This will be followed by the discussion of the papers on the two new steelmaking processes.

The remaining three sessions will be devoted to the use of computers in the iron and steel industry. Mr. W. F. Cartwright, president of the institute for 1960-61, will open the proceedings with a general survey of the present and future roles of the computer in iron and steel making, and the session on the afternoon of May 3 will conclude with a discussion on computers in research and design, with papers from BISRA, the Linde Company, and the United Steel Companies, Limited.

On the morning of May 4 there will be informal discussions on the use of computers for process control (in-line). Speakers from the Netherlands, the UK, and the USA will consider the application of computers to cutting up steel products and in mill and furnace control.

The final session will be on the use of computers in production control, information, etc. The subjects of the papers to be discussed include iron-ore mining, casting-bay programmes, invoicing, and production planning. Their authors are from Stewarts and Lloyds, Steel, Peech & Tozer, the Steel Company of Wales, and SOLLAC (France).

CREEP IN METALS AND ALLOYS

ORGANIZED by the Iron and Steel Institute and the Institute of Metals, a symposium on structural processes in creep is to be held at Church House, Great Smith Street, London, S.W.1, on May 3 and 4.

There will be three sessions. The first, on the afternoon of May 3, will be devoted to the more theoretical aspects of the subject. The morning and afternoon sessions on May 4 will be concerned with creep in non-ferrous and ferrous metals and alloys, respectively.

Participation in the symposium is open to members of the two institutes and their guests. Applications from non-members will be accepted. Details may be obtained from the Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1.

JAPANESE industrialists and commercial organizations are reported to be interested in the mineral resources of Sarawak, particularly the coal mine at Silantek, where a rich coking coal reserve has been found.

Correspondence

INVENTORS OR COPYISTS?

To the Editor of IRON AND COAL

SIR,—Your leading article (March 24) was most timely. All thoughtful persons in the steel industry have been wondering for years when the one-way "import" of ideas would be reversed. One of my own experiences may interest some of your readers.

In 1949, a foreigner visited a well-known firm in this country to offer a revolutionary type of recuperator that could withstand any temperature almost up to the melting point of any commercial refractory. (Its possible use on a one-way fired open-hearth furnace was an obvious application.) The official of the firm concerned dismissed him and his offer in a matter of minutes. I followed up the history of this invention myself and discovered that, within weeks of the meeting that I have mentioned, a world-famous American company with international ramifications took steps leading to subsequent world patent rights in the invention. I last heard that the recuperator was being used in an oil refinery and some other plant the name of which escapes me at the time of writing.

Again, we led the world in our work demonstrating the importance of a study of aerodynamic fluid flow to good furnace design. Now we import the offspring of this work in the form of open-hearth furnaces from abroad.

It is obviously easier for consulting engineers and contractors to make relatively slight alterations to old drawings than to design from scratch, when tendering. This seems to raise the question of to what extent the industry might create its own consulting engineering organization that could obtain prices and prepare full schemes for its members, etc. Much more of its latest central research organization's work might thereby find the light of day sooner, in a practical sense.

Perhaps a different approach still is needed, based, significantly enough, upon the statement accorded to one of Mr. Spencer's own colleagues, that "everyone who entered the works had something to offer it and was entitled to have his opinions heard."—Yours faithfully,

R. E. H. WILLIAMS.

Southmoor,
Acaster Malbis,
Near York.
March 29, 1961.

DEPENDENCE ON COAL

To the Editor of IRON AND COAL

SIR,—I feel it might be advisable to elaborate on your editorial of April 7, when you state that 8 per cent. of our people are dependent on coal for a livelihood. It suggests a static position.

In the last 10 years the output of coal in Canada has halved as a result of replacement by rival fuels. In the same period in the USA, output has wavered slightly, but manpower has halved through doubled productivity. John L. Lewis said he was quite content if the American economy could exist without one man going to work in the mines. Europe is laying pipelines and waterways to use oil and gas direct from the Sahara and by tankers from elsewhere.

While, in your previous issue, it was stated that Russia finds coal three times as expensive as oil and 12 times as natural gas, she cannot spare men for coal, but has planned large increases for oil and natural gas.

Unless it is intended to retain a large portion of our industry as a museum of nineteenth century life, I suggest 8 per cent. be stressed as an *expense* on the economy, as well as a source of wealth. The debatable factor is the rate at which this 8 per cent. be *reduced* through improved productivity.

In this connection, it would be of value to have a realistic interpretation from British Communists as to why they fight to retain low productive pits in this country at any human cost.

I hope you can find someone more authoritative to give this point of view if you yourself do not wish to express it in an editorial.—Yours faithfully,

DONALD HINDSON, JR.

109, Worsborough Road,
Bridwell,
Near Barnsley,
Yorks.
April 10, 1961.

Film Show for Yorkshire Colliery Managers

A FILM show was given at the meeting of the Yorkshire Branch of the National Association of Colliery Managers held on March 14. After showing of "Supply Line," which deals with the planning and building of a new stockyard and the saving of time and labour in taking materials underground, with special emphasis on method study, Mr. E. Brammer commented on the advantages of a trackless vehicle rather than the diesel locomotive.

The methods used in the national demonstration tunnel at Ashton Moss were shown in a film called "Tunnelling Technique." The complete cycle was covered in detail, proving how, with average equipment and a normal team, tunnelling speeds could be increased to three or four times their previous rate. After this film, comments were made by Mr. C. Machin, production director, and Mr. W. Lomas, tunnelling engineer, North-Eastern Divisional Coal Board.

The third and final film was "Firedamp Roof Layers," which explains that firedamp can form layers near roadway roofs and accumulate in cavities. Two firedamp explosions, one involving a roof layer, and one involving an accumulation in a cavity, were reconstructed by models and diagrams. After the film, a brief talk was given by Mr. J. Blunt, safety engineer of the North-Eastern Divisional Coal Board.

Obituary

MR. A. B. DAWSON

ONE of Cumberland's most popular mining engineers, Mr. Arthur Bond Dawson, died at his home at Sandwith, Whitehaven, last week. He was 66. Mr. Dawson spent his whole working life in Cumberland, and was in turn chief surveyor at Risehow Colliery Coking & By-Product Company, Limited, chief surveyor for the Whitehaven mines, manager at William and Ladysmith collieries, engineer to the Cumberland Coal Company (Whitehaven), Limited, and adviser to the Birkby Coal Company, Limited, Maryport.

At nationalization of the industry in 1947, Mr. Dawson was appointed planning and development engineer for the Cumberland Area of the Northern Division of the National Coal Board. A life member of the National Association of Colliery Managers, he was president of the Cumberland branch from 1955 to 1957. Last December, the Institute of Mining Engineers awarded him the Douglas Hay Medal in recognition of his published work on the ventilation of gassy seams. He was also awarded the Greenwell Medal by the Institute in 1944, and has contributed a number of articles on technical mining subjects to IRON AND COAL.

MR. C. A. LLOYD

FOR 33 years a director of Stewarts and Lloyds, Limited, manufacturers of tubular steel products, steelmakers, etc., of Glasgow, Mr. Cecil Ambrose Lloyd died on Monday, aged 90. Educated at Repton, he spent 18 months in a London chartered accountant's office before becoming, in 1890, a partner in the firm of Lloyd & Lloyd, Limited, tube manufacturers, of Birmingham.

In 1902 when the firm amalgamated with Stewarts, of Glasgow, and became Stewarts and Lloyds, Limited, Mr. Lloyd was appointed a director for the Birmingham region. He held this position until he retired in 1935.

PROF. C. W. DANNATT

FORMER professor of mining and metallurgy, Imperial College of Science, and Technology, London, Prof. C. W. Dannatt has died at the age of 68. The title of Professor Emeritus of Metallurgy in the University of London was conferred on him when in 1957 he retired from the Chair of Metallurgy at the Imperial College.

From 1937 to 1946 when he became Professor of Metallurgy in the University of London, Prof. Dannatt was Reader in Metallurgy, and earlier, from 1923, he was lecturer and demonstrator. As head of the Metallurgy Department he made many improvements in the laboratories and in the courses of instruction in his department.

Mr. WILLIAM EDWARD COLEMAN, senior first aid officer for No. 6 Area, South-Western Divisional Coal Board, has died aged 64. Mr. Coleman was an authority on first-aid in coal mines.

Managing director of Francis & Jenkins' Successors, Limited, makers of forgings, edge tools, etc., and one of the oldest established industries in Llanelly, Mr. HUGH GUEST REES, died last week. He was 71.

Former manager of the wire mill at the Doncaster factory of British Ropes, Limited, Mr. T. W. F. BOLLAND has died, aged 61. He served the company for most of his working life, retiring some time ago.

Mr. JOHN HARRISON, chief draughtsman and machine tool engineer with H. W. Kearns & Company, Limited, machine tool manufacturers, of Altrincham (Cheshire), until his retirement three years ago, has died at the age of 77.

Mr. LEONARD HARTLEY, chairman of Clayton Son & Company, Limited, gas and structural engineers, of Hunslet, Leeds, has died at the age of 77. Last year he completed 60 years' association with the firm, which was founded by his great-uncle in 1864.

The death has occurred of Mr. A. H. ASKEW, an expert in ironstone mining in Cleveland (Yorkshire), at the age of 84. He was for some years manager of Boulby Mines, Cleveland, and before his retirement was mining agent for the Skelton and Zetland Estates.

Formerly managing director of New Monckton Collieries, Limited, and the Monckton Coke & Chemical Company, Limited, Mr. ARTHUR CECIL FREDERICK ASSINDER has died. He was 73. He joined the group as a colliery manager some 40 years ago and retired on the nationalization of the coal industry.

Mr. RICHARD KIRCHNER, who has died at the age of 52, was deputy chairman and joint managing director of Arnott & Harrison, Limited, engineers' toolmakers, of London, N.W.10, and a director of Crawford Collets, Limited, spring collet makers, of Witney (Oxon). He was a vice-president and a founder member of the Gauge and Tool Makers' Association.

The death has occurred at the age of 73 of Mr. ALBERT JAMES HUMPHRIS, former treasurer of the Industrial Salvage and Recovery Council, Midland Region. He was at one time works manager of Emery Bros., Limited, non-ferrous metal rollers, etc., of Birmingham, consulting engineer to several undertakings, vice-chairman of the Industrial Advisory Council on Salvage, and a member of its national council.

Recent Wills

PROBYN, F. E. C., chief mechanical engineer at the Ebbw Vale Works of Richard Thomas & Baldwins, Limited, since 1958, and a past president of the Ebbw Vale Metallurgical Society £8,381

BROWN, MRS. ALICE SIDNEY GEORGE, a co-founder with her husband, the late Mr. S. G. Brown, of S. G. Brown, Limited, precision instrument makers, of Watford, and a former director of the Telegraph Condenser Company, Limited £311,140

ATKINSON, ROBERT MORTON, chairman of Sulzer Bros. (London), Limited, mechanical engineers, London, W.C.1, and a director of Richardsons, Westgarth & Company, Limited, and George Clark & North Eastern Marine (Sunderland), Limited £62,089

BOSWELL, PROF. P. G. H., Professor of Geology at the Imperial College of Science and Technology, and head of the Department of Geology, Oil Technology and Mining Geology, 1930-38, formerly Herdman Professor of Geology at Liverpool University £10,586

ICKE, S. C., a former chairman and managing director of Brooke Tool Manufacturing Company, Limited, Birmingham, who retired in 1939. He was also a former director of Lister Tools, Limited, Wolverhampton, and of Arthur Scrivener, Limited, machine tool manufacturers, of Birmingham ... £491,678

VERULAM, LORD, chairman of Enfield Rolling Mills, Limited, and of Engineering & Lighting Equipment Company, Limited, and Sternol, Limited, former managing director of Enfield Cables, Limited, a director of the London Committee of the District Bank, Limited, and member of the council of the Industrial Welfare Society £17,398

IRON AND STEEL TRADE

GENERALLY, it would appear that the steel industry has settled down to a steady rhythm of production. Without interrupting to any great extent the high outputs which have been maintained, the extensive destocking and the resultant limited forward ordering has shortened delivery periods Now that orders have begun to flow again more easily, specifications for plate and structural shapes—the most notable examples—are more realistically related to current output which, at its present rate, gives every sign of reaching the estimate of 24,500,000 tons for the year.

Pig-iron

The blast furnaces are being kept fully occupied. Record outputs of basic pig-iron are being regularly achieved and in a number of cases the more modern furnaces are exceeding the capacity figures originally claimed for them. The steelworks continue to absorb large tonnages, a much higher proportion than normally owing to the spasmodic supply of suitable scrap.

The ironfoundries are also well supplied with pig-iron and are experiencing no difficulty in obtaining the grades needed. Orders for the low phosphorus irons and hematite are readily met, nor are there any delays in supplying the refined and high phosphorus irons.

Ferro-alloys

The Easter holiday has had little effect on demand for most items. The major grades of ferro-silicon are well supported, and there is a good demand for ferro-chrome and ferro-manganese. Steady attention is given to both ferro-titanium and ferro-niobium.

Ferro-tungsten is unchanged in price and is attracting fairly steady support at a rather uninspired level. There is a fair demand for ferro-vanadium and ferro-molybdenum.

Semi-finished Steel

Reasonably good outputs are recorded by the re-rollers although the level of demand has fallen slightly for all items with the exception of reinforcing rods and bars. Orders for small bars, light sections, steel strip, and bright drawn bars could increase considerably before causing the re-rollers any problems of supply.

Most of the re-rollers have good stocks of mild steel semis and the call on home steelworks is being curtailed until the stocks are lowered to manageable proportions. The position is not so easy for carbon and alloy steel billets.

Finished Steel

Orders for sections and joists are still somewhat restricted, but there are reports in some areas of a slight improvement in demand. Makers of plate are still working all out to satisfy requirements.

Cold reduced sheets are still obtainable for reasonable delivery and the improvement in the motor industry is taking a long time to filter through to the suppliers. Galvanized sheets, cold reduced strip, and bright drawn bars are still easy, except in the case of free cutting and alloy qualities, the latter being persistently scarce.

CONTRACT WORTH £6,000 for demineralization and de-aeration plants has been awarded to William Boby & Company, Limited, water treatment engineers, of Rickmansworth (Herts), by Burt, Boulton & Haywood, Limited.

Iron-making Plant Completed at Durgapur

WITH the satisfactory testing of No. 3 blast furnace, now ready for operation, the entire iron-making facilities at the Durgapur Steelworks, West Bengal, India, have been completed. Like its predecessors, No. 3 is rated to produce 1,250 tons of iron per day and this output has already been frequently exceeded on No. 1 and No. 2 blast furnaces. The iron-making plant will produce hot metal for the melting shop and iron for foundry uses.

The three blast furnaces are fed by a comprehensive coke, iron-ore, and limestone handling system feeding into bunkers on the furnace high line. All raw materials are carried from the bedding plant by a conveyor system, although provision has also been made for feeding the furnaces by rail-borne raw materials.

The iron-making plant at Durgapur has been designed and erected by a member company of the Indian Steelworks Construction Company, Limited, (ISCON).

Ferro-alloy Prices

(Per ton, unless otherwise stated, delivered)

FERRO-SILICON (6-ton lots and over)—45 per cent. Si, £45 to £48, scale 15s. per unit, lumpy; 75 per cent. Si, £59 to £63 10s., scale 15s. per unit, lumpy.

FERRO-VANADIUM—50/60 per cent., 22s. 6d. per lb. of V.

FERRO-MOLYBDENUM—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

CALCIUM MOLYBDATE—12s. 4d. per lb. of Mo.

MOLYBDIC OXIDE BRIQUETTES—11s. 10d. per lb. of Mo, delivered United Kingdom.

FERRO-BORON—23/25 per cent., 7s. 6d. per lb.

FERRO-TITANIUM—20/25 per cent., 2-3 per cent. Cu, £220 to £250; 38/40 per cent., commercially carbon-free, £287.

FERRO-TUNGSTEN—80/85 per cent., 9s. 11d. per lb. of W.

TUNGSTEN METAL POWDER—98/99 per cent., 12s. 11d. per lb. of W.

FERRO-CHROME (6-ton lots and over, lumpy)—4/6 per cent. C, £81 10s. to £84 10s., basis 60 per cent. Cr scale 27s. to 28s. 6d. per unit; over 6 per cent. C, £79 to £82 10s., basis 60 per cent. Cr, scale 27s. to 28s. 6d. per unit; max. 2 per cent. C*, to 1s. 8d. to 1s. 11d. per lb. Cr; max. 1 per cent. C*, 1s. 8d. to 1s. 11½d. per lb. Cr; max. 0.15 per cent. C*, 1s. 9½d. to 2s. 0¼d. per lb. Cr; max 0.10 per cent. C*, 1s. 9¾d. to 2s. 0¾d. per lb. Cr; max. 0.06 per cent. C*, 1s. 11d. to 2s. 1d. per lb. Cr.

METALLIC CHROMIUM—98/99 per cent., 6s. 10d. per lb.

METALLIC MANGANESE—94/96 per cent., carbon-free, £275; 96/98 per cent., £285.

FERRO-COLUMBIUM—65/67 per cent., Cb+Ta, 19s. 9d. per lb. Cb+Ta.

FERRO-MANGANESE (home)—78 per cent., £58 10s.

**Average 68-70 per cent. Cr.*

THE BIGGEST CARGO of iron ore ever shipped into the Tees—18,354 tons of Venezuelan ore for Dorman Long (Steel), Limited—began unloading last Friday.

Coalfield News

NCB Trainee for "Apprentice of the Year"

NORMAN RILEY, a management trainee with the National Coal Board, has won the Sheffield and District heat of the "Apprentice of the Year" competition organized by the British Junior Chamber of Commerce. He will now go forward to the Yorkshire regional finals and, if successful, to the national finals. His success was achieved in competition with apprentices from many other industries.

Mr. Riley started as a haulage hand at Kiveton Park Colliery in the No. 1 (Worksop) Area, North-Eastern Divisional Coal Board. Now, at 23 years of age, he is passing through the board's management training scheme which will equip him after appropriate experience to take a high post within the industry. By way of the board's schemes for the training of craft apprentices and student apprentices, he obtained Ordinary and Higher National Certificates (with credits) and is now working at the No. 1 (Worksop) Area Central Workshops.

COAL AND COKE EXPORTS from the South Wales ports last week were up on the comparable Easter week last year. The total of 39,041 tons was 6,378 tons better.

PRESENTATIONS were made to Mr. S. Charlton, undermanager at East Hetton Colliery (Co. Durham), to mark his appointment as manager of Bowburn Colliery.

COAL SHIPMENTS from the Hartlepools during the 12 weeks ended March 27 dropped to 345,033 (380,483) tons. Foreign shipments were down to 1,338 tons, compared with 6,747 tons a year ago.

NCB PLAN for a temporary extension of open-cast mining for anthracite and coking coal will not be opposed by South Wales miners. This decision was reached by the Area executive of the National Union of Mineworkers in Cardiff on Tuesday.

ANOTHER MEETING with the South-Western Divisional Coal Board has been suggested by the Glamorgan River Board in an attempt to overcome river pollution. Unsatisfactory coal washery effluents are believed to be one of the principal causes of the trouble.

TO MARK their retirement after a combined total of 99 years at the coal face, presentations have been made to Mr. John Williams (65) and Mr. Henry Biggs (60) both deputies at Fenton Colliery, North Staffordshire Area of the West Midlands Division of the NCB. Mr. Williams has been a deputy for 34 years and Mr. Biggs for 38 years.

CHOSEN AS Mayor-elect of Wallsend (Northumberland) is Cllr. J. H. Branch, who has worked at the Rising Sun Colliery, Wallsend, since 1923. He has been chairman of the local branch of the National Union of Mineworkers for the past 12 years, and has been a member of Wallsend Council since 1949. He received the BEM in 1959.

IN THE FIRST-AID FINALS in the West Midlands Division of the NCB at Bushbury, Wolverhampton, the senior competition was won by Haunchwood Colliery (Warkwickshire), and the junior competition by Hilton Main (Cannock Chase). The senior individual competition was won by A. Slade (Littleton) and the junior individual competition by R. Dyde (Newdigate). The winning teams will represent the division in the NCB national finals at Blackpool on April 22.

Charting British Coal Seams

FIRST showing of a new type of atlas which will run eventually to about 180 volumes was given by the National Coal Board on Tuesday. The purpose of the atlas, each volume of which will deal with one of the more important coal seams in Britain, is to show the variation of each seam, not only in depth, structure, and thickness, but also in properties that affect the quality and use of the coal.

So far 11 volumes—in folio form—have been printed and cover at least one major seam in each coalfield. A further nine are close to completion and work on 10 more is proceeding. The maps are the result of 30 years' work by the Coal Survey.

The properties affecting quality which are being charted include ash content, the proportion of sulphur (which for metallurgical coke must be low), chlorine (unpopular in power stations because it causes troubles in superheater tubes), "rank" and volatile matter in coal, and the amounts of carbon, hydrogen, and phosphorus.

Stopping Pit Recruitment was a Mistake Says Report

ACCORDING to the triennial report on the youth employment service, issued last Saturday by Stirlingshire Education Committee for the years 1957 to 1960, the suspension of recruitment after the coal mining industry had been reorganized did great harm to the industry. No young men were recruited for over a year during 1958-59 and it has since proved increasingly difficult to interest boys in employment with the National Coal Board, the report adds. Even a trickle of young entrants would have helped to keep the industry alive for potential school-leavers.

The ban on recruitment is illustrated in figures which the report gives on the entries into various trades and professions. The average number of boys taken into coal mining and quarrying industries during 1957-60 was 73, whereas the average for the 1954-57 period was 137.

Welsh Boxers Hope to Retain NCB Titles

GOOD support is assured for the southern finals of the mineworkers' boxing championships, to be held at the Gwyn Hall, Neath, next Friday. The northern finals were held at Hamilton's Town Hall last Friday, and the bouts at Neath will decide the programme for the national finals at the Civic Hall, Wolverhampton, on May 5.

At Neath, divisional champions from the West Midlands, East Midlands, and South-Eastern divisions will meet the South-Western divisional champions. The boxers from the South-Western Division are hoping to repeat their great success of last year's finals at Glasgow, where, in addition to winning five individual national titles, they won the two national trophies.

Mr. A. R. ROBERTSON has been appointed registrar of the United Steel Companies, Limited.

THE COAL TRADE

FROM a number of districts come reports of an improved demand for most grades of house coal—a somewhat unusual feature of the market just before the advent of summer prices. Many of the larger merchants are reducing stocks to the minimum compatible with meeting the probable demand over the next fortnight—also with summer prices in mind. Now that the pressure for premium-grade smokeless fuels has eased, the more prompt delivery that merchants can give makes for much better trader-consumer relationships.

WEST MIDLANDS

Recent ordering has been confined to a few hundredweights at a time. Merchants now are having to lay-off vehicles and at most depots there is a sizeable number of wagons under demurrage. A problem which is bothering merchants is that of the extended use of credit schemes, entailing the employment of additional capital. Selling coal on hire purchase is not new to this district, the greater part of some merchants' business being done this way. The burden of laying-down depot stocks which may have to be carried for several months is also becoming increasingly difficult.

All grades of house coal are on offer, while the position in respect of premium fuels has eased appreciably. The supply of anthracite has improved, but best quality stove nuts and beans remain comparatively tight. Merchants are stocking any small surpluses even though winter prices still prevail. There are few complaints of insufficient supplies of small anthracite, provided the customer's requirements have been registered in good time, and delays in the delivery of Welsh dry steam nuts and special-purpose fuels have ceased. The demand for coke has fallen away and buying is now for immediate consumption requirements only.

All grades of industrial coals are readily available, though there is no great surplus of sizes used on mechanical stokers. The hard coke market remains irregular. A very good feature is blast-furnace coke, but general purpose qualities are weaker. Hard coke nuts are very difficult to move especially now that summer prices are approaching. Foundry descriptions attract a good deal of support, especially the popular brands from South Wales.

ECSC Aid for Miners Affected by Belgian Pit Closures

APPLICATION by Belgium for financial help for mineworkers affected by the closure of eight Belgian pits has been passed by the High Authority of the European Coal and Steel Community. Some 5,000 miners are involved. The Authority has placed credit of 44,900,000 Belgian francs at the government's disposal, and this sum is to be complemented by one of the same amount from the Belgian government. The eight pits concerned, in the Borinage, Centre, and Charleroi coalfields, which are producing about 900,000 metric tons a year, were announced as due for closure by the Belgian Coal Council last December. Of the 5,000 workers, 3,800 are face workers.

The Belgian coal marketing organization, Cobéchar, has presented the High Authority with new price lists containing prices 20 to 115 fcs. per metric ton lower than former basic rates. At the same time, the Authority has granted an increase of 70,000 tons in each direction in the current Belgian-Dutch coal trade.

Coal Consumption and Output Reaching Parity

WITHIN 50,000 tons, output of saleable coal in Easter Week at 2,730,700 tons was at about the same level as the comparable week in 1960. The output so far this year is almost 52,000,000 tons, compared with over 57,000,000 tons last year. However, with the productivity figures steadily rising it is likely that the two totals will come more into line as the year advances.

Consumption is also coming into line with output and there is a definite slackening now in the call on coal reserves. In the week ended April 1 undistributed stocks fell by less than 200,000 tons and seem unlikely to drop much below the present total of 23,185,000 tons.

Consumers' stocks are also falling slightly, indicating the clearance of present stocks before summer prices come in.

There were 578,310 wage-earners on colliery books on April 1, against 614,790 on April 2, 1960, the numbers engaged at the coal face being 217,340 and 236,040 respectively. Total absenteeism (all workers) in the week ended April 1 was 15.77 per cent., compared with 14.95 per cent. in the week ended April 2, 1960. Output at the face was 4.103 tons and overall 1.415 tons in the week ended April 1, compared with 4.017 and 1.428 tons in the week ended April 2, 1960.

The following tables gives (in tons) the revised output of saleable mined coal by division in the week ended April 8, and the tonnage lost through all causes (holidays, disputes, and go-slows):—

Division.	Week ended April 8, 1961.		Week ended April 23, 1960.*
	Total output.	Tonnage lost.	Total output.
Scottish ..	358,000	2,000	374,000
Northern (N&C) ..	187,000	50,000	184,000
Durham	361,000	96,000	341,000
North-Eastern ..	474,000	340,000	463,000
North-Western ..	189,000	50,000	211,000
East Midlands ..	590,000	269,000	602,000
West Midlands ..	159,000	120,000	170,000
South-Western ..	251,000	105,000	257,000
South-Eastern ..	19,000	11,000	19,000
Great Britain—			
Deep-mined coal ..	2,588,000	1,043,000	2,621,000
Other deep-mined (including licensed mines) ..	36,000	—	36,000
Opencast coal ..	107,000	—	123,000
TOTAL	2,731,000	1,043,000	2,780,000

* Comparable week last year.

Board Changes

GEC Vice-Chairman is Sir Toby Low

IT is announced by the GENERAL ELECTRIC COMPANY, LIMITED, that Sir Toby Low, Conservative MP for Blackpool North, has been elected vice-chairman of the company. There has not been a vice-chairman since Mr. Arnold Lindley, who held that position, succeeded Sir Leslie Gamage as chairman at the beginning of the year.

It is also announced that Mr. M. Sobell and Mr. A. Weinstock, chairman and managing director respectively, of Radio and Allied (Holdings), Limited, have been elected directors of GEC, as has Lord Coleraine.

MANCHESTER SHIP CANAL COMPANY—Sir Cuthbert B. Clegg and Mr. W. Collingson have resigned from the board.

THOMAS BLACK, LIMITED—Mr. A. F. Hartley has been elected to the board. He will continue as secretary of the company.

HOLSET ENGINEERING COMPANY, LIMITED—Mr. R. B. Hesselden is appointed to the board. He is succeeded as works manager by Mr. R. Barr.

SECOMASTIC, LIMITED—Mr. E. L. Townsend has been appointed chairman, and Mr. C. G. Tudor Pole succeeds Mr. Townsend as managing director.

GABRIEL & COMPANY, LIMITED—Mr. G. D. Wilkins, company secretary, and Mr. G. A. Spencer, works manager, have been appointed special directors.

ALCAN INDUSTRIES, LIMITED—Mr. A. A. Bruneau, company secretary, and Mr. R. J. Moyse, chief financial officer and treasurer, have been elected directors.

BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED—Dr. L. R. Blake has been appointed to the new post of director of engineering and has joined the board as an executive director.

NEWTON, CHAMBERS & COMPANY, LIMITED—Mr. W. Washbourne, general manager of the excavator division, has been appointed to the boards of two of the subsidiaries, NCK-Rapier, Limited, and Rhodes & Halmshaw, Limited.

HARGREAVES (LEEDS), LIMITED—Mr. Geoffrey D. Lavers has been appointed assistant managing director. He joined the company in 1945 and after serving in various subsidiary companies was made a director of the parent in 1956.

FBI SCHEME FOR SHARING SCIENTIFIC EQUIPMENT

SCHEME for sharing scientific equipment between industrial companies in south-east England has been started by the London and south-eastern region of the Federation of British Industries. It is believed to be the first arrangement of its kind in England and Wales.

A large proportion of the 126 industrial firms represented in the region's research directors' discussion group have submitted two lists of items of equipment—one of items they are prepared to make available to other companies: the other of equipment to which they would like to have access. These lists are now being circulated to all members of the group with the suggestion that "offerers" and "seekers" should get in direct contact. It is hoped that other companies will participate.

Monopoly Unions and "Spineless" Management

PRACTICES of monopolistic trade unions, and "spineless" managements, were strongly criticized by Mr. Graham Hutton, the economist, in a talk to the British Institute of Management in London on Thursday of last week. Mr. Hutton said that while there was legislation which stopped managements and employers from engaging in certain listed practices, it was unfair and stupid that this did not apply to trade unions. Unions and their leaders "enjoy virtually complete freedom to paralyse selected firms or entire industries, rig their labour costs for them, snatch the instruments of management from the managers' hands, and otherwise conduct themselves on the industrial plane with complete disregard for their enhanced powers and responsibilities."

Mr. Hutton accused management of being afraid to put a foot wrong with the unions, the Government, and the public services. "It is, in short, dismembered and incoherent." The "Alice Through the Looking Glass" tax system was largely responsible, he thought, for a lot of the apathy, laziness, resignation and sheer despair in the upper ranks of UK management. "There is no really commensurate material reward either for the firm or for the manager even if they do pull off their coats, roll up their sleeves, and get on their toes."

He advocated three major reforms in the economy—the overriding Governmental determination to stop domestic inflation at the monetary end, laying industries open to more oversea competition, and proper anti-monopoly legislation and procedures. He claimed that a half per cent. rise in overall productive efficiency each year would see the UK and its currency out of recurrent crises and would go far to overcome domestic inflation.

Industrial Peter and Government Paul

THOSE in charge of large industries get tired of being told how they should do their job. The Government urged firms to increase their export trade and afterwards industry was faced with a substantial increase in material costs imposed by the Government. This criticism was made by Mr. F. B. George, managing director of the Consett Iron Company, Limited, addressing insurance company representatives at Consett recently.

Sometimes industry was told to increase production, but it had to pay an increased tax on every extra ton produced. Industries were requested by the Government to develop and spend more on research, but, said Mr. George, after taxation they were not left with enough to do so. "Some people seem to think that industry has some magic chest and can carry any sort of burden," he commented.

One of the greatest difficulties facing the nationalized industries, he believed, was public interference, and he admitted that he did not know how any industry could be carried on under a continual barrage of questions in Parliament.

Dr. A. W. HENDERSON has been appointed chief chemist-metallurgist of the Plessey Company, Limited, Ilford (Essex).

COMPANY NEWS

KIRKSTALL FORGE ENGINEERING, LIMITED—It is proposed to divide the 10s. ordinary shares into 5s. shares and at the same time make a scrip issue of one new 5s. ordinary share for every 10s. share.

BRITISH BELTING & ASBESTOS, LIMITED—The 15 per cent. forecast for 1960 is being exceeded by a final of 11½ per cent. making 17½ per cent. for the year. Group net profits increased to £796,358 (£730,628).

FRED. TEMPERLY & SON, LIMITED—The company, a subsidiary of the Hepworth Iron Company (Engineering), Limited, has acquired for cash the share capital of Herbert Brooke & Company (Fireclay), Limited, Burnley.

BARROW HEPBURN & GALE, LIMITED, belting manufacturers, of London, S.E.1—The company's offer for ordinary shares of Samuel Barrow & Company, Limited, has now become unconditional, sufficient acceptances having been received.

WARSOP POWER TOOLS, LIMITED—Subject to contract, agreement has been reached for amalgamation with the Fram Reinforced Concrete Company, Limited, and the Russell Building & Contracting Company, Limited, two private companies which work in association with each other.

C. A. PARSONS & COMPANY, LIMITED, engineers, turbine makers, etc., of Newcastle-upon-Tyne—The dividend is to be increased to 2s. 6d. (1s. 10½d.) per £1 share with a final of 1s. 7d. Group profit rose sharply to £5,267,063 (£3,478,690) and the net profit is £2,699,666 (£2,209,114).

ACROW (ENGINEERS), LIMITED, engineers and builders' plant manufacturers, of London, W.C.2—Second quarterly dividend of 12½ per cent. makes 25 per cent. to date on account of the year ending March 31, 1961, against the previous year's equivalent, adjusting for a one-for-10 scrip issue, of 22.72 per cent.

A. REYROLLE & COMPANY, LIMITED, manufacturing electrical engineers, of Hebburn (Co. Durham)—A final dividend of 6¼ per cent. makes 9¾ per cent. for 1960 on a capital doubled by a scrip issue. The previous year's equivalent was 8¾ per cent. After tax the net profit of £1,560,306 compares with £1,428,021.

HERBERT MORRIS, LIMITED, makers of cranes, handling equipment, etc., of Loughborough (Leics)—Announcing an interim dividend of 4 per cent., the chairman, Mr. Frank Morris states that the volume of orders has continued at a high level and the value of orders on hand is substantially higher than a year ago.

F. PERKINS, LIMITED, diesel engine makers, etc., of Peterborough—Group profit, after charging all expenses including £498,352 extraordinary loss on scrapping machinery and equipment, is £1,246,577 (£1,301,882 for 10 months). Group net profit is £940,730 (£1,092,407). No final dividend is recommended.

JAMES N. CONNELL (HOLDINGS), LIMITED, scrap iron and machinery merchants, of Coatbridge (Lanarkshire)—Profit for the year to February 28, 1961, amounts to £151,027 (£134,174) and, after tax, the net balance is £68,416 (£72,046). A dividend of 15 per cent. is being paid, as forecast last November when the company became public.

STEWARTS AND LLOYDS, LIMITED—An interim dividend of 5 per cent. is to be declared on the present ordinary capital of £27,000,000 and a final of 10 per cent. is forecast on the capital as increased to £33,000,000 by the forthcoming rights issue. Last year an interim of 3 per cent. and a final of 12 per cent. were paid on £27,000,000 capital.

COWANS SHELDON & COMPANY, LIMITED, engineers, crane builders, and ironfounders, of Carlisle—The offer by Clyde Crane & Booth, Limited, to acquire all the issued capital has been accepted by the holders of more than 80 per cent. of the capital. Subject to permission to deal in the new Clyde Crane shares, the offer has now become unconditional.

VOSPER, LIMITED, shipbuilders and marine engineers, of Portsmouth—The company, a subsidiary of Minerals Separation, Limited, reports a heavier loss of £29,828 (£17,142) for 1960, and is not paying a dividend, against 10 per cent. for 1959. The order-book is currently much larger and better balanced than at this time last year, and the outlook is more promising, the directors state.

JOHN CASHMORE, LIMITED, iron and steel stockholders, machine-tool merchants, etc., of Tipton (Staffs)—Without implying that the current year's total distribution will be increased, the dividend is being increased to 22½ (17½) per cent. for the year ended January 31, 1961, and a one-for-three scrip issue is proposed. After tax of £237,000 (£197,000), net profits are £227,196 (£188,959).

NEWMAN INDUSTRIES, LIMITED, electrical and mechanical engineers, of Yale, Bristol—The ordinary dividend is being raised by 2½ per cent. to 15 per cent. for 1960. Holders of the 6 per cent. cumulative participating preferred ordinary again receive their 8 per cent. maximum, with a 2 per cent. participating dividend. Group net profit was £102,086 (£88,645) after taxation of £81,708 (£53,500).

BEYER, PEACOCK & COMPANY, LIMITED, locomotive engineers, steel, brass and iron founders, etc., of Manchester—Group profit for 1960 recovered to £321,864 (£72,092) and the dividend is maintained at 12 per cent. After tax of £143,283 (£73,682) the net balance is £178,581 (loss of £1,592). Group profit of the subsidiary the Anti-Attrition Metal Company, Limited, was £20,739 (loss £95,686).

RANSOMES SIMS & JEFFERIES, LIMITED, engineers and ironfounders, makers of agricultural machinery, etc., of Ipswich—Group profit, before tax, fell from £870,810 to £791,536 for 1960. The dividend is held at 7½ per cent. Sales and profits for 1960 suffered from the wet autumn, but since the end of the year have shown improvement, it is stated. After a lower tax charge, the net balance is £400,555 (£406,212).

PROJECTILE & ENGINEERING COMPANY, LIMITED, London, S.W.8.—Net profit is up from £137,994 to £149,448, after tax of £140,143 (£127,336) for 1960, and the dividend is raised to 18 (15) per cent. with a final of 12 per cent. Output in the metal pressing division increased by nearly one-fifth compared with the previous year, it is stated, and in the machinery division more machines were made and sold than in 1959.

VULCAN FOUNDRY, LIMITED—Holders of the £100,000 5 per cent. cumulative preference stock will be asked at a meeting in May to approve repayment of their capital at par. It is proposed to restore the authorized capital to its present figure of £1,000,000 and to make a scrip issue to the parent company, English Electric Company, Limited, of 100,000 £1 ordinary shares.

English Electric will then own the entire issued capital of £945,097.

METAL CLOSURES, LIMITED, West Bromwich (Staffs)—The group has acquired 51 per cent. of the capital of Ideal Capsules Australia (Pty), Limited, for £131,200 cash. The remaining 49 per cent. is held by G. E. Crane & Sons, Limited, an Australian packaging firm. Ideal Capsules is the principal maker in Australia of metallic bottle capsules and one of the leading makers of aluminium foil food containers. Net profits, before tax, in 1960 were £38,717.

EDWARDS HIGH VACUUM, LIMITED—Group trading profit increased from £295,851 to £363,127 and the dividend is raised from the equivalent of 13¼ per cent. to 15 per cent. with a final of 10 per cent. It has been agreed to acquire the capital of one of the principal sub-contractors, J. H. Holmes & Son, Limited, precision engineers, of Lancing (Sussex), for about £38,000 cash and 35,000 Edwards 4s. ordinary shares. Mr. J. J. Holmes will continue as its managing director.

CROFTS ENGINEERS (HOLDINGS), LIMITED, power transmission engineers, of Bradford—Volume of work on hand at the end of the year showed a considerable increase over the previous year, and for the first two months of 1961 orders booked compared favourably with 1960, states Mr. John A. Croft, chairman. With new plant working to capacity, and given a reasonable period of price stability, the chairman is optimistic that the group will show marked progress during 1961. Contributions to profits in 1960 by oversea subsidiaries was higher.

Davis & Timmins Profits are Doubled

MORE than doubled net profits for 1960, an increase of 15 per cent. in the distribution, and a further one-for-four scrip issue are announced by Davis & Timmins, Limited, screw, nut and bolt manufacturers, of London, E.17. Final dividend is 20 per cent. and in addition there is a cash bonus of 5 per cent. both on capital increased by a one-for-10 rights issue. A 10 per cent. interim was paid prior to the rights issue, but after a one-for-four scrip issue.

The 35 per cent. total dividend compares with the equivalent of 20 per cent. paid for 1959, taking the scrip issue into account. Group net profit increased to £293,999 (£135,586) after tax of £262,674 (£117,138). At the meeting to be held on June 2 it is proposed to increase the authorized share capital by £250,000.

BROWN BAYLEY'S DEVELOPMENT SCHEME

PRESENTING his annual statement, Mr. J. W. Garton, chairman of Brown Bayley Steels, Limited, Sheffield, says that the development scheme, approved by the Iron and Steel Board towards the end of last year, should give an increased output of alloy and stainless steels of about 30,000 tons a year.

The scheme includes a new 32-in. mill which will replace the existing 27-in. cogging stand and involves the rearrangement of furnaces, buildings and transference of plant. It should take four to five years to complete and cost some £2,000,000. When completed, the company will have installed over a period of 10 years new steel melting plant, a new forge, and a rolling mill.

Record Year for Atlas Copco Group

PORTABLE compressors manufactured by the British and Belgian factories accounted for a considerable proportion of the sales of the Atlas Copco group in 1960. The group sales figure of £33,100,000 is a record and represents an increase over 1959 of £6,900,000. The group, which manufactures air compressors, rock drills, engineers' tools, etc., comprises a parent company in Stockholm and daughter companies in 28 countries throughout the world. Its sales have more than doubled in the past six years. The two British companies are Atlas Copco (Great Britain), Limited, the British sales company, and Atlas Copco (Manufacturing), Limited, makers of portable air compressors and contractors' pneumatic tools for home and export.

The parent company made a net profit in 1960 of £807,601, compared with £560,304 in 1959.

Simon Engineering Trading Results for 1960

GROUP profit of £2,812,977 was recorded by Simon Engineering, Limited, for 1960, against £2,821,550 in 1959. Taxation accounted for £1,485,677 (£1,496,377), and profit attributable to Simon Engineering was £1,344,596 (£1,456,422). Due to the substantial changes in the structure of the group during 1960, a precise comparison with the previous year's results is not possible, it is stated. The figures for 1959 have been obtained by aggregating the results of Henry Simon (Holdings), Limited, and Simon-Carves, Limited, after adjusting for the inter-company holdings.

A final dividend of 17½ per cent. is being paid, making 27½ per cent. for 1960. The final is payable on capital increased by 170,709 shares of 5s. issued against the acquisition of W. S. Barron & Son, Limited, and the total compares with the forecast of 26¾ per cent. made in May in connection with the merger of Henry Simon (Holdings), and Simon-Carves. The dividend now recommended is equivalent to 41¼ per cent. on the shares held by holders in both companies prior to the merger, and compares with 35 per cent. paid by both companies in respect of 1959.

Law Cases

SHOTFIRER'S NEGLIGENCE

SHOTFIRER with 37 years' experience in the coal-mining industry, George Brown Ramage, was fined a total of £23 at Dunfermline Sheriff Court on six charges of contravening the Coal Mines Explosives Act. It was alleged that, while underground at Comrie Colliery, he had charged six shots within 90 ft. of three others; coupled the detonator circuit wrongly; failed to determine the danger zone of the explosion; fired shots without posting sentries; and failed to test for gas before firing the shots.

Prosecuting, the fiscal said: "The accused was very negligent in leaving underlings to carry out matters which were his own concern. As a result two of the three miners still left in the section were injured."

[Mr. Ramage collapsed at the pit bottom at Comrie Colliery last Friday and died before he could be brought to the surface.]

NEWS IN BRIEF

RAW STEEL PRODUCTION in the US during the week ended April 3 totalled 1,632,000 net tons, according to the Iron and Steel Institute. This was a 1.3 per cent. increase over the 1,611,000 tons produced in the preceding week.

FOR THE NEXT five months, 250 men will be kept in full employment by the eight ship-repair contracts booked by Austin & Pickersgill, Limited, Sunderland (Co. Durham). The company has increased its labour force from 100 men to meet the inflow of extra work.

REPORTING IN London on Tuesday on the operation of a Leo II computor installed at the company's Corby iron and steel works, Mr. R. M. Johnson, of Stewarts and Lloyds, Limited, said that 600 manual workers are being paid at their own request by bank credit transfer.

DELEGATION of Russian engineers of the Scientific and Technical Committee of the USSR Council of Ministers will visit the Wallsend, Sunderland, and Hartlepool works of Richardsons, Westgarth & Company, Limited, the marine and general engineers, from April 24—April 26.

NEW WAREHOUSE, costing £100,000, is to be built to relieve the storage problem at the West Bromwich (Staffs) factory of George Salter & Company, Limited, manufacturers of springs, spring balances, weighing machines, etc. The warehouse is expected to be completed and in use early next year.

TOWN PLANNING approval has been given to the United Steel Companies, Limited, Sheffield, to develop 108 acres of land near Coal Aston, 10 miles south of Sheffield, which has been bought for use as an airstrip by the company's aircraft. Work is proceeding on the preparation of an 800-yd. grass runway.

THE TWO large steel castings which have been recovered from the coaster Lurcher which sank in the Mersey estuary 11 weeks ago are now undergoing rigorous tests to make certain no damage was caused by their immersion. The castings are for the new slabbing mill at Ravenscraig of Colvilles, Limited.

PRODUCTION RECORD of the LKAB Kiruna Mines in Northern Sweden was broken in March when a total extraction of 1,210,000 tons of iron ore was achieved —the highest figure reached in one month. Of this quantity about 75 per cent. was produced underground. The previous record was 1,140,000 tons, made last November.

SALES AND ADVERTISING executives of northern industrial concerns have agreed to form a new association. The body, which will be known as the Industrial Marketing Association, will be open to executives concerned with the marketing of industrial goods and capital equipment as opposed to consumer products sold to the public.

LICENCE AGREEMENT has been concluded with Rini International, whereby the Plessey Company, Limited, general engineers, radio, electronic and instrument manufacturers, etc., of Ilford (Essex), will manufacture Rini thermal overload protectors and starting relays, with the exclusive marketing rights in the UK and non-exclusive rights elsewhere, except Italy.

GALVANIZED IRON formerly handled by their joint subsidiary, Dreistern Thyssen Blech, GmbH, Düsseldorf, is now being marketed individually by August Thyssen-Hütte, AC, Duisburg-Hamborn, and Siegener, AG, Geisweid. Siegener is handling its production of hot-rolled galvanized sheets through its own marketing organization, while the marketing of August Thyssen-Hütte cold-rolled strip galvanized iron and coils, galvanized sectional sheets and structural units has been taken over by its recently formed subsidiary, Thyssen Industrie, GmbH, Dinslaken.

TO SEEK a long-term remedy for the growing shortage of skilled engineering workers in the area, and to help solve the problem of the growing bulge in school-leavers seeking careers in industry, Heenan & Froude, Limited, manufacturing engineers, of Worcester, is to take 37 apprentices a year instead of the present 25. More modern equipment is to be put at the disposal of trainees.

GEAR-CUTTING FACTORY, which will employ 400 men, is to be opened in Sunderland (Co. Durham), by David Brown Industries, Limited, a division of David Brown Corporation, Limited. The works will be established in the former No. 1 factory of Bristol Siddeley Engines, Limited. Initiative in bringing the company to Sunderland was taken by the Board of Trade, to help reduce the level of unemployment in the town.

JOINT COMPANY is to be formed this month by AEI Lamp & Lighting Company, Limited, and the General Electric Company, Limited, for the manufacture and sale of molybdenum, tungsten, and other metal products associated with the electric lamp and radio valve industries. The new company is expected to begin trading as a separate company within a few months, with headquarters at North Wembley (Middx).

IN CONNECTION WITH the shaft-sinking record set up on February 1 by the Thyssen Shaft Sinking Company, Limited, at Kellingley Colliery (Yorks), Bedrock tipped drill steels, 1 in. hexagon section, manufactured by John Bedford & Sons, Limited, Sheffield, were used throughout the drilling. For the first 700 ft. through frozen ground, cross-bit integral steels were used, and for later drilling, through the coal measure itself, chisel bit integral steels.

DEVELOPMENT in the field of shop load scheduling will be dealt with at a series of two-day seminars arranged by Materials Management International, Limited, in May. The seminars, conducted by Mr. W. Imbrie, general manager of Mauchly Associates, management planning consultants, will be on May 11 and 12 (Waldorf Hotel, London), May 15 and 16 (Midland Hotel, Birmingham), and May 17 and 18 (Grand Hotel, Manchester).

FULLY SELF-CONTAINED and mobile equipment has now been designed and completed by the installation division of Causeway Reinforcement, Limited, Northfleet (Kent), enabling it to carry out almost every type of welding technique without recourse to an outside power supply. Although the unit is equipped for general welding contracts, its primary purpose is to assist in the installation of Causeway Hexmetal refractory linings and heavy duty floors.

THE FORMATION BY Dewrance & Company, Limited, manufacturers of boiler mountings, pipe line, valves, etc., of London, S.E.1, of the Dewrance metals division is announced. It will consist of the foundry at Hillington (Norfolk) and the special alloys division in London. It will have its own board of management and will be responsible for the production and sales of high-quality non-ferrous castings, nickel alloy castings, stainless steel castings, and "Endewrance" hard facing and high temperature brazing alloys. Production executive, Mr. J. B. Morton, is based at Hillington and the sales and technical executive, Mr. E. Wallace, is situated in London.

New Look for London Metal Exchange

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The speakers all agreed that there was widespread commendation for the quality of British goods. There was criticism of delivery promises not being kept, but Mr. Senior said this did not apply to Norway. There was, however, a feeling, he said, that makers of alloy and tool steels were not attacking the Norwegian market as they should. There was a big market there, especially for stainless steel.

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Mr. C. V. Peake to Move to North-Eastern NCB

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Born in 1918 of a well-known mining-engineering family, Mr. Peake was educated at Bedford School and subsequently took his degree in Mining Engineering at Birmingham University after studying coal mining in Yorkshire, Cannock Chase, and the continental coalfields. Shortly after starting work underground at Bretby Colliery in South Derbyshire, he joined the Forces and eventually was appointed quarry superintendent to the director of opencast coal production, Government of India. He was made MBE for his work in India.

Returning to the East Midlands coalfield after the war he was later appointed manager of Cannock Wood Colliery, West Midlands Division. In 1952, Mr. Peake became Mining Development Engineer, No. 4 Area, East Midlands Division, and, in 1955, deputy Area production manager of the Division's No. 5 Area. He was appointed Area production manager in 1956.

During recent years Mr. Peake has carried out much experimental work in connection with coal cutting and the mechanization of operations close to the coalface.

Mining Switchgear Firm's Development in Scotland

SWITCHGEAR manufacturers, engineers, and brassfounders, Wallacetown Engineering Company, Limited, Ayr, has extended its manufacturing facilities at a new site at Heathfield (Lanarkshire). Work at the site, which covers 14,000 sq. ft., began recently. Wallacetown is one of the leading makers of flameproof switch and control gear for underground use in the mining industry, and is also concerned with the manufacture of motor control gear for use in the iron and steel, and chemical industries, and materials handling plant.

The company, which exports about 15 to 20 per cent. of total production, has recently completed a contract worth £110,000 for the National Coal Development Association of India.

New Ashington Training Centre

THE Preliminary Training Centre at Ashington Colliery (Northumberland), was transferred on Tuesday to Ashington Mining School. The work of the school, which has trained students for coalfields throughout Britain, is being transferred to the recently completed County Mining and Technical College which is also in Ashington.

The college includes playing fields, gymnasium, equipment, and workshops, and trainees will continue to use the underground training galleries at Carl Pit, Ashington.

LEEDS FIRECLAY COMPANY, LIMITED—Mr. C. F. Grafton has resigned from the board.

Spectacular Win in NCB Boxing Championships

IN the Northern finals of the National Coal Board Boxing Championships, held at Hamilton (Lanarkshire), last Friday, Scotland won five of the 10 bouts and will be well represented in the national finals to be held at the Civic Hall, Wolverhampton, on May 5.

Charley Rae, Scottish light-middleweight champion, had a spectacular knock-out win when in the final round he knocked his opponent, D. Holt (North-Western Division), through the ropes. International flyweight, Alex Young, boxing for Valleyfield Colliery, had a hard battle to beat C. Wilcox (North-East Division) on points.

Results:—Flyweight: A. Young (Valleyfield) beat C. Wilcox (No. 3 Area, N.E. Division) on points. Bantamweight: D. Moreby (No. 4 Area, N.E. Division) beat D. Donald (No. 7 Area, Scottish Division) on points. Featherweight: T. Halpin (No. 4 Area, N.E. Division) beat C. Salter (No. 2 Area, Scottish Division) on points. Lightweight: G. Whitaker (No. 7 Area, N.E. Division) beat J. Welsh (No. 3 Area, Scottish Division) k.o. first round. Light-welterweight: P. O'Rorke (No. 2 Area, N.E. Division) beat D. Pyne (No. 1 Area, N.W. Division) on points. Welterweight: F. Powney (No. 2 Area, N.E. Division) beat R. Christie (No. 1 Area, Scottish Division) on points. Light-middleweight: C. Rae (No. 1 Area, Scottish Division) k.o.'d D. Hold (No. 1 Area, N.W. Division) in the third round. Middleweight: J. Fisher (No. 4 Area, Scottish Division) beat J. Short (No. 4 Area, Durham Division) on points. Light-heavyweight: J. Rafferty (No. 2 Area, Scottish Division) beat J. Taylor (No. 5 Area, N.E. Division), bout stopped in first round. Heavyweight: J. Rae (No. 3 Area, Scottish Division) beat K. Booth (No. 3 Area, N.E. Division) on points.

The East Midlands Divisional championships, the winners of which go forward to the Southern finals to be held at Gwyn Hall, Neath (Glam), on April 21, also took place last Friday. Making his sixth appearance in the championships, J. T. Bowdell (25), of Church Gresley Colliery (Staffs), retained his divisional heavyweight championship title when he beat Geoff McArthur, of Moorgreen Colliery, Newthorpe (Notts), on points at Edwinstowe (Notts). Bowdell's cousin, Jack Bowdell, the reigning divisional champion at light-heavyweight, had no opponent and retained his title.

Results:—Lightweight: D. Johnson (Cadley Hill) beat A. Holmes (Worsop Main) on points. Light Welterweight: M. T. Tunney (Thoresby) beat F. Hannant (Silverhill) on points. Bantamweight: M. J. Mann (Thoresby) beat G. Shields (Creswell) on points. Middleweight: E. Hallam (Bevercotes) beat L. Keeling (Langton), referee stopped contest in second round. Light Middleweight: J. Smith (Mansfield) beat G. Lyons (Sherwood) on points. Welterweight: E. P. Davidson (Glapwell) beat D. Lindley (High Moor), referee stopped contest in first round. Featherweight: K. G. Brett (Bevercotes) walk-over—his opponent A. F. Mann (Thoresby) failed to pass the medical examination.

NEYVELI LIGNITE CORPORATION, southern India, has granted a West German consortium an order worth DM. 75,000,000 (over £6,250,000) for a briquetting and carbonization plant plus boiler and turbines, the plant to briquette and carbonize local brown coal for metallurgical and household use.

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Mr. C. V. Peake to Move to North-Eastern NCB

AT present production manager, No. 5 Area, East Midlands Divisional Coal Board, Mr. Cecil Vowe Peake has been appointed general manager No. 6 (North Barnsley) Area, North-Eastern Divisional Coal Board. He is expected to take over the post on May 1. The vacancy has arisen from the recent retirement of Mr. H. J. Atkinson.

Born in 1918 of a well-known mining-engineering family, Mr. Peake was educated at Bedford School and subsequently took his degree in Mining Engineering at Birmingham University after studying coal mining in Yorkshire, Cannock Chase, and the continental coalfields. Shortly after starting work underground at Bretby Colliery in South Derbyshire, he joined the Forces and eventually was appointed quarry superintendent to the director of opencast coal production, Government of India. He was made MBE for his work in India.

Returning to the East Midlands coalfield after the war he was later appointed manager of Cannock Wood Colliery, West Midlands Division. In 1952, Mr. Peake became Mining Development Engineer, No. 4 Area, East Midlands Division, and, in 1955, deputy Area production manager of the Division's No. 5 Area. He was appointed Area production manager in 1956.

During recent years Mr. Peake has carried out much experimental work in connection with coal cutting and the mechanization of operations close to the coalface.

Mining Switchgear Firm's Development in Scotland

SWITCHGEAR manufacturers, engineers, and brassfounders, Wallacetown Engineering Company, Limited, Ayr, has extended its manufacturing facilities at a new site at Heathfield (Lanarkshire). Work at the site, which covers 14,000 sq. ft., began recently. Wallacetown is one of the leading makers of flameproof switch and control gear for underground use in the mining industry, and is also concerned with the manufacture of motor control gear for use in the iron and steel, and chemical industries, and materials handling plant.

The company, which exports about 15 to 20 per cent. of total production, has recently completed a contract worth £110,000 for the National Coal Development Association of India.

New Ashington Training Centre

THE Preliminary Training Centre at Ashington Colliery (Northumberland), was transferred on Tuesday to Ashington Mining School. The work of the school, which has trained students for coalfields throughout Britain, is being transferred to the recently completed County Mining and Technical College which is also in Ashington.

The college includes playing fields, gymnasium, equipment, and workshops, and trainees will continue to use the underground training galleries at Carl Pit, Ashington.

LEEDS FIRECLAY COMPANY, LIMITED—Mr. C. F. Grafton has resigned from the board.

Spectacular Win in NCB Boxing Championships

IN the Northern finals of the National Coal Board Boxing Championships, held at Hamilton (Lanarkshire), last Friday, Scotland won five of the 10 bouts and will be well represented in the national finals to be held at the Civic Hall, Wolverhampton, on May 5.

Charley Rae, Scottish light-middleweight champion, had a spectacular knock-out win when in the final round he knocked his opponent, D. Holt (North-Western Division), through the ropes. International flyweight, Alex Young, boxing for Valleyfield Colliery, had a hard battle to beat C. Wilcox (North-East Division) on points.

Results:—Flyweight: A. Young (Valleyfield) beat C. Wilcox (No. 3 Area, N.E. Division) on points. Bantamweight: D. Moreby (No. 4 Area, N.E. Division) beat D. Donald (No. 7 Area, Scottish Division) on points. Featherweight: T. Halpin (No. 4 Area, N.E. Division) beat C. Salter (No. 2 Area, Scottish Division) on points. Lightweight: G. Whitaker (No. 7 Area, N.E. Division) beat J. Welsh (No. 3 Area, Scottish Division) k.o. first round. Light-welterweight: P. O'Rorke (No. 2 Area, N.E. Division) beat D. Pyne (No. 1 Area, N.W. Division) on points. Welterweight: F. Powney (No. 2 Area, N.E. Division) beat R. Christie (No. 1 Area, Scottish Division) on points. Light-middleweight: C. Rae (No. 1 Area, Scottish Division) k.o.'d D. Hold (No. 1 Area, N.W. Division) in the third round. Middleweight: J. Fisher (No. 4 Area, Scottish Division) beat J. Short (No. 4 Area, Durham Division) on points. Light-heavyweight: J. Rafferty (No. 2 Area, Scottish Division) beat J. Taylor (No. 5 Area, N.E. Division), bout stopped in first round. Heavyweight: J. Rae (No. 3 Area, Scottish Division) beat K. Booth (No. 3 Area, N.E. Division) on points.

The East Midlands Divisional championships, the winners of which go forward to the Southern finals to be held at Gwyn Hall, Neath (Glam), on April 21, also took place last Friday. Making his sixth appearance in the championships, J. T. Bowdell (25), of Church Gresley Colliery (Staffs), retained his divisional heavyweight championship title when he beat Geoff McArthur, of Moorgreen Colliery, Newthorpe (Notts), on points at Edwinstowe (Notts). Bowdell's cousin, Jack Bowdell, the reigning divisional champion at light-heavyweight, had no opponent and retained his title.

Results:—Lightweight: D. Johnson (Cadley Hill) beat A. Holmes (Worsop Main) on points. Light Welterweight: M. T. Tunney (Thoresby) beat F. Hannant (Silverhill) on points. Bantamweight: M. J. Mann (Thoresby) beat G. Shields (Creswell) on points. Middleweight: E. Hallam (Bevercotes) beat L. Keeling (Langton), referee stopped contest in second round. Light Middleweight: J. Smith (Mansfield) beat G. Lyons (Sherwood) on points. Welterweight: E. P. Davidson (Glapwell) beat D. Lindley (High Moor), referee stopped contest in first round. Featherweight: K. G. Brett (Bevercotes) walk-over—his opponent A. F. Mann (Thoresby) failed to pass the medical examination.

NEYVELI LIGNITE CORPORATION, southern India, has granted a West German consortium an order worth DM. 75,000,000 (over £6,250,000) for a briquetting and carbonization plant plus boiler and turbines, the plant to briquette and carbonize local brown coal for metallurgical and household use.

NIFES Reports Big Increase in Orders

REPORTING to the board of the National Industrial Fuel Efficiency Service, its managing director, Dr. W. Angus Macfarlane, states that during the first quarter of this year the demand for NIFES services reached a record level. The value of orders placed with NIFES in the financial year 1960-61 is 21 per cent. higher than in the previous year.

The number of detailed heat and power surveys completed in factories and commercial premises has now passed the 3,250 mark. These surveys are being devoted more and more to improving the heat-using processes in the factories as well as improving the efficiency of boiler-house plants.

Dr. Macfarlane goes on to state that fuel savings, which on average amount to 20 per cent., have in many instances also been accompanied by increased output from the plants and better quality products.

More than 900 NIFES clients now have regular service agreements whereby their premises are regularly visited by NIFES engineers, who assist the firms to maintain their boiler houses, process plants and heating plants at the highest possible level of efficiency. A comprehensive programme of refresher and training courses is planned during this year.

UK Fuel Efficiency Expert to Advise Indian Industry

PROGRAMME of investigation lasting six months into fuel consumption at selected Indian factories has been started by a member of the National Industrial Fuel Efficiency Service, Mr. C. A. J. Plummer, who left for Delhi last week. The visit coincides with the launching of India's third 5-year plan, and follows an application made last year by the Indian Government for an expert in fuel economy to advise selected industries on problems of fuel and steam conservation.

The tour, arranged under the Colombo Plan, and with the Commonwealth Relations Office, will include several days discussion at the Ministry of Commerce and Industry in Delhi, after which Mr. Plummer will move to Calcutta for two months' work with the Indian Coal Control Organization, where he will be joined later by another NIFES engineer, Mr. B. R. Addicott, who will assist in the investigations. Mr. Plummer joined NIFES in 1954, after holding previous posts with Carbo-Ice Industries, Limited, and at the Ministry of Fuel and Power, and has recently been in charge of its Birmingham office and Midland area.

A NATIONAL CONFERENCE organized jointly by the Institution of Engineering Inspection and the Society of Non-Destructive Examination, is to be held at Oxford in September, to discuss the function of management in relation to inspection, the economics of inspection and non-destructive testing, and the recruitment, education, and training of inspection staffs. The conference is being planned at the request of the Joint Committee of Materials and their Testing and the British National Committee for Non-Destructive Testing. Total cost will be £9 10s. per delegate and further information may be obtained from the Oxford Conference Secretariat, Institution of Engineering Inspection, 616, Grand Buildings, Trafalgar Square, London, W.C.2.

CISWO Gives £1,250 for Yorkshire Scout Hut

CHEQUE for £1,250, representing the cost of a new hut for training adult scout leaders at the Yorkshire County Scout Camp at Hesley Wood, Chapeltown, was presented last weekend to the Earl of Scarbrough, as Yorkshire County Scout president, by Mr. H. A. Fish, chairman of the North-Eastern Division of the Coal Industry Social Welfare Organization Youth Council.

CISWO has given the cheque because it is estimated that in South Yorkshire alone—and not the whole of Yorkshire which the camp serves—there are over 3,000 scouts who come from mining families. The hut is 96 ft. long, can accommodate over 150, and is the biggest in the camp.

Guests attending the opening ceremony included, Mr. R. S. Baker, deputy-chairman of the North-Eastern Divisional Coal Board, and Mr. F. Collindridge, secretary of the Yorkshire Area of the National Union of Mineworkers.

WORKING MECHANIZED COAL FACE AT CAREERS EXHIBITION

WORKING mechanized coal face mounted by the Cumberland Area of the Northern (N&C) Divisional Coal Board at the Careers Exhibition held recently at Workington College of Further Education was seen by about 6,000 people. The "mine" consisted of approach galleries and a coal face equipped with Anderton shearer loader, armoured conveyor and self-advancing supports.

All the equipment was under power and in continuous operation, with modern face telephone system, automatic cut-out, and face lighting. Visitors heard, between runs, a recorded commentary by Mr. A. Baines, Area mechanization engineer, and were also able to question the attendants—members of the Area mechanization team.

An indoor exhibition centred on a model winder complete with shaft and cages. There were also panels of modern electrical equipment and scientific and coal preparation displays, as well as signalling and automatic telephone systems. The "daylight" mine is to have another week's run at Haig Colliery, Whitehaven.

INDUSTRIAL GROWTH OVERSEA

CONFERENCE to be held by the British Institute of Management at Brighton on April 26 and 27 will discuss the problems facing UK companies operating oversea and those studying the opportunities that are arising. The theme of the conference will be "Industrial Growth in Developing Countries" and it will be opened by Sir John Elliot, director of the Commonwealth Development Corporation.

Among those contributing papers will be Mr. K. D. Brough, managing director of the Metal Box Company (Overseas), Limited, and Mr. John Marsh, director of the Industrial Welfare Society, and Dr. M. F. Garcia, president of Motores Perkins, SA, will come from São Paulo to present a case study of the setting up, in Brazil, of the subsidiary company of F. Perkins, Limited. Mr. M. I. Prichard, managing director of the parent company, will also take part.

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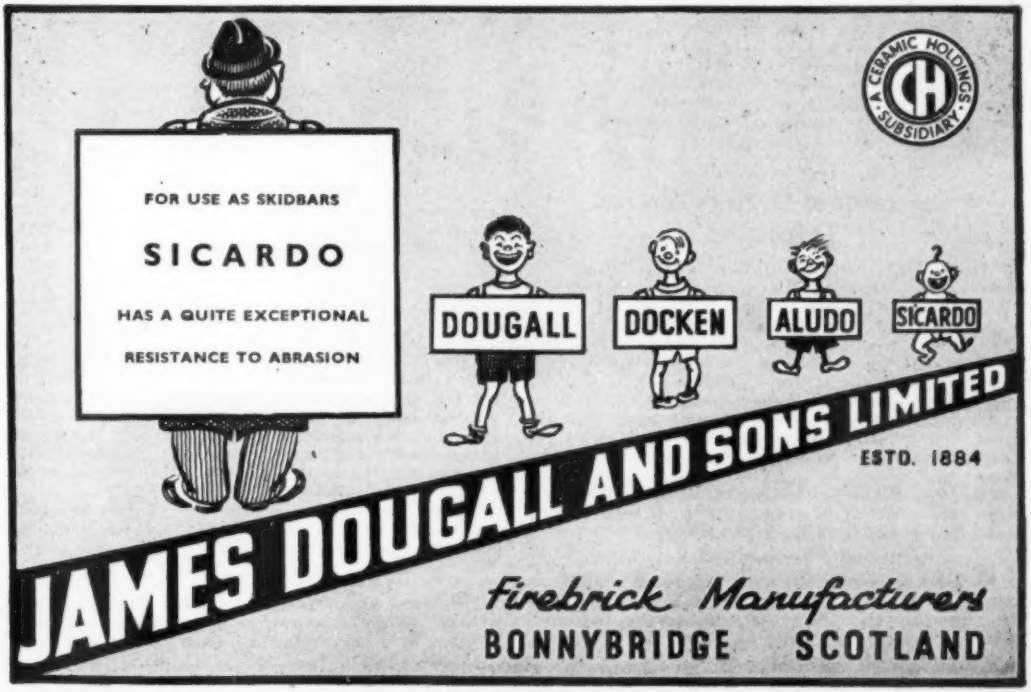


General Hydraulic Power Merger

SUBJECT to shareholders' approval, agreement for a merger on a share exchange basis has been reached between the boards of the General Hydraulic Power Company, Limited, London, S.E.1, and Hugh Smith (Glasgow), Limited, Langley Alloys, Limited, Slough (Bucks), and Brentford Transformers, Limited, Crawley (Sussex).

The merger will be effected by the issue of shares to the value of about £1,250,000 in General Hydraulic Power (which is to be renamed the G.H.P. Group, Limited), for the share capitals of the three companies. If the offers are accepted in full the issued ordinary capital of GHP will be increased from £603,153 to £1,945,593, of which existing shareholders will hold 31 per cent.

The directors of GHP estimate that the combined profits of the four companies for the year 1961 will be not less than £330,000, equivalent, after profits tax, to approximately 13¼ per cent. on the ordinary capital of GHP as increased.

GHP, which was formed in 1882, is a holding company with three main operating subsidiaries. Hugh Smith, which was incorporated in 1935 to take over a family business, produces heavy and medium machine tools, hydraulically or mechanically operated, designed primarily for shipbuilders, steel fabricators, boilermakers, and other industries concerned in the bending, shaping, and cutting of heavy plates and sections.

Langley Alloys was incorporated in 1939 and produces a variety of special copper nickel-base and stainless steel alloys in the form of castings, forgings, and dropforgings. Brentford Transformers, which was formed in 1936, produces stepless on-load voltage regulation and stabilizing equipment for medium and heavy duty electric power applications.

Basis of exchange is 12 GHP £1 ordinary for five £1 shares of Hugh Smith; 11 GHP ordinary for six Langley £1 ordinary, and 4 GHP ordinary for five Brentford 5s. ordinary units. Members of the three companies will be entitled to special interims out of profits earned before December 30, 1960.

Underground Carriage Contract Transferred

CONTRACT for 450 underground carriages for London Transport Executive has been transferred from the Birmingham Railway Carriage & Wagon Company, Limited, to the Metropolitan-Cammell Carriage & Wagon Company, Limited. Birmingham Railway Carriage & Wagon Company asked for the cancellation of the contract because it said it could not fulfil it unless its workers agreed to take a wage cut. London Transport will not pay more than the price first quoted; any increase will be paid by the first company as a condition of its release from the contract.

Delivery of the new rolling stock will begin early next year. Metropolitan-Cammell is already making 589 cars for London's Underground.

IN VIEW OF recent important legislative changes, a course of lectures on Industrial and Factory Law will be given by Mr. Harry Samuels at the Industrial Welfare Society's headquarters, 48, Bryanston Square, London, W.1, on May 9-11.

British Export Missions

BRITISH exports to Europe can be substantially expanded if existing opportunities are seized promptly, and full regard paid to individual country's requirements. This is the general finding of members of the Export Council for Europe following "pathfinder" missions recently made to Austria, Denmark, France, Italy, Norway, Portugal, Spain, Sweden, and Switzerland. Detailed reports by each team are now being studied by the Council as a whole, which is to publish its full findings and recommendations next month.

The reports have confirmed the value of the missions, says the Council, and further ones are planned to Ireland, West Germany, Holland, Belgium and Luxembourg, Turkey, Finland, Greece, and Iceland. Among members of coming missions will be: Ireland (April 17-21), Mr. R. W. Weekes, managing director, the Harland Engineering Company, Limited; West Germany (May 1-6), Sir William McFadzean, chairman of the Export Council for Europe, and chairman of British Insulated Callender's Cables, Limited; Mr. A. M. Browne, chairman and managing director, Hackbridge & Hewittic Electric Company, Limited; Mr. O. F. Reichwald, managing director, Daniel Adamson & Company, Limited; and Mr. J. C. Snow, director, Snow & Company, Limited.

Belgium and Luxembourg (May 1-5), Mr. R. W. Weekes; Turkey (May 7-10), Dr. A. Caress, director, Imperial Chemical Industries, Limited; Finland (May 22-25), Sir Norman Kipping, director general of the Federation of British Industries; Mr. Brian Rootes, managing director, Rootes, Limited; Greece (May 28-June 1), Mr. J. Hugh Neill, deputy chairman and joint managing director, James Neill & Company (Sheffield), Limited; Yugoslavia (between August 21 and 29), Sir William McFadzean, Mr. Peter Tennent, oversea director of the Federation of British Industries.

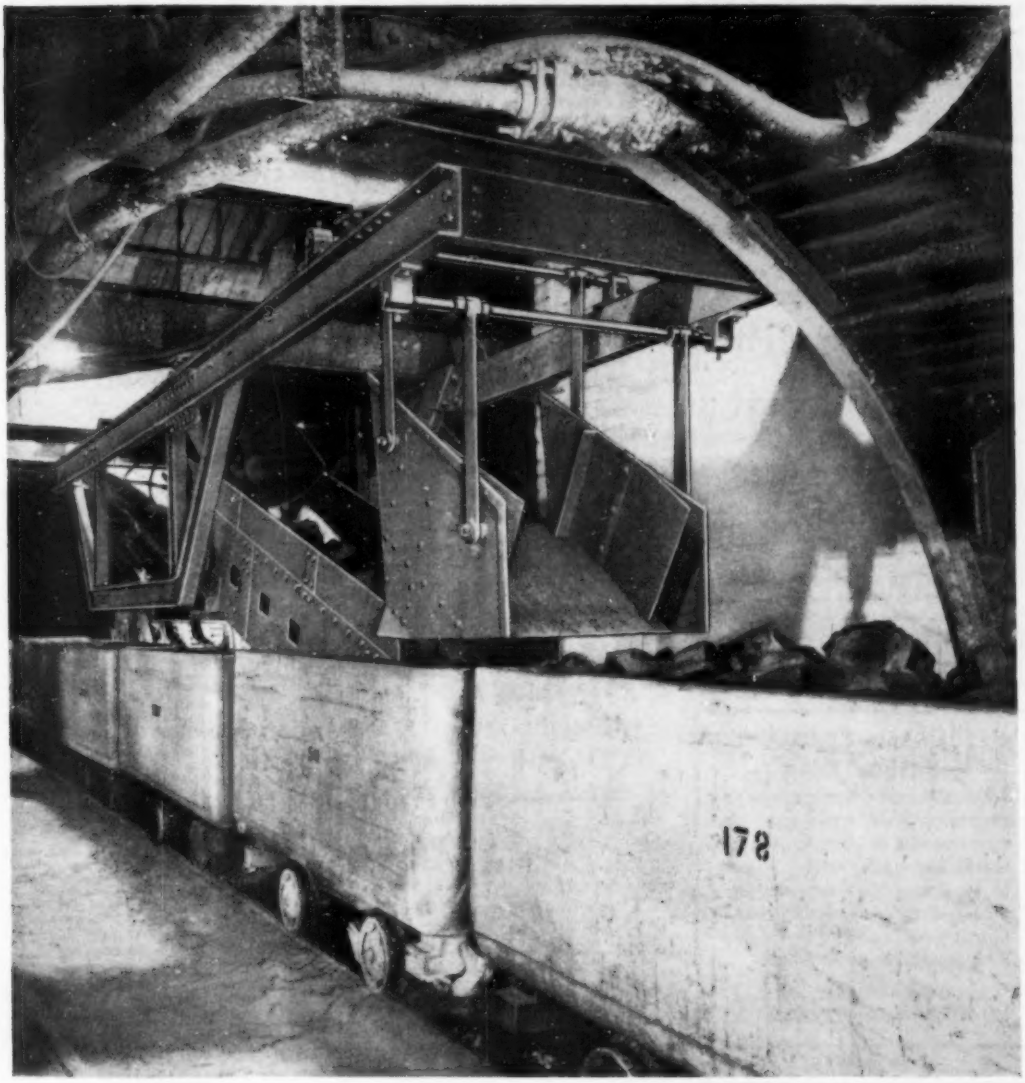
Electrical Equipment for Rolling Mills

AGREEMENT has been concluded between Bruce Peebles & Company, Limited, Edinburgh, and REGA Brucker & Company, Segburg, Germany, for the joint production and marketing of complete electrical equipments for the operation and control of ferrous and non-ferrous hot and cold rolling mills. This agreement unites in this field the resources of the two organizations, each of which has had extensive experience in the design and manufacture of electrical equipment incorporating the most advanced techniques in the specialized rolling field.

Under the arrangements made in the agreement, which covers the supply of equipment in the whole of the UK and in Eire, rotating machines and rectifiers will be built by Bruce Peebles, and the electronic controls, programming, optimization, and automatic gauge control equipment will be designed by REGA Brucker and manufactured either by them, or, under licence, by Bruce Peebles.

Among the activities already in progress are contracts entailing full responsibility for the complete electrical equipment for several rolling mills.

DUE TO A FALL in demand for hot dipped tinplate, workers at the Abercarn (Mon), works of Richard Thomas & Baldwins, Limited, have been placed on a four-day week.



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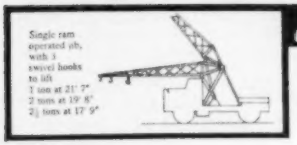

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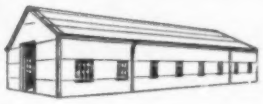

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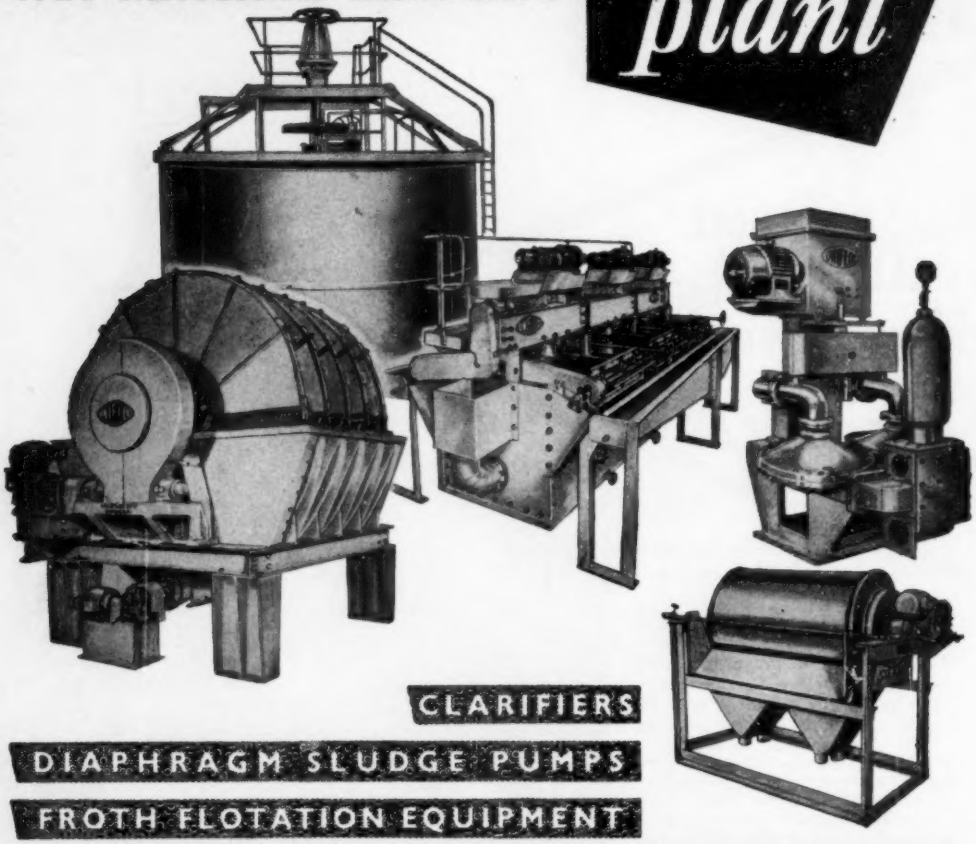

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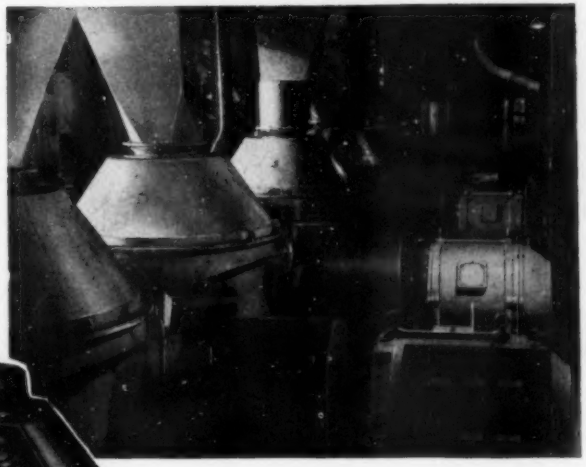


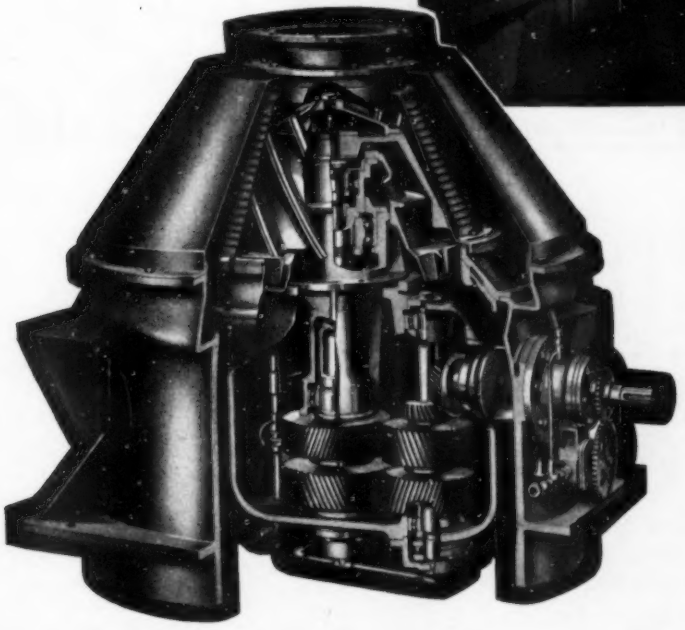
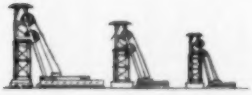


Illustration shows four of twelve centrifuges in operation at Manvers Main.



A cut-away illustration showing the basic construction of a Reineveld Centrifuge.

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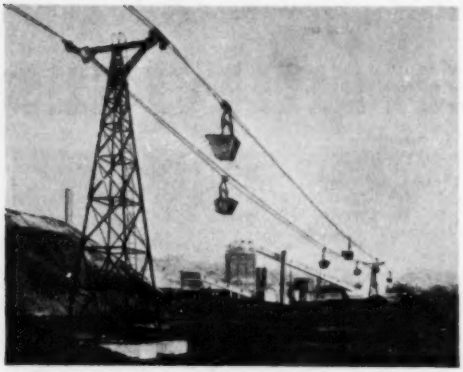

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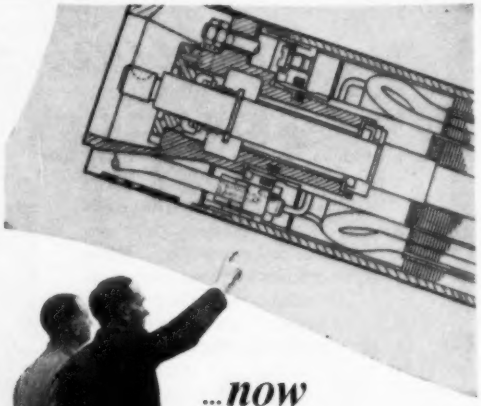

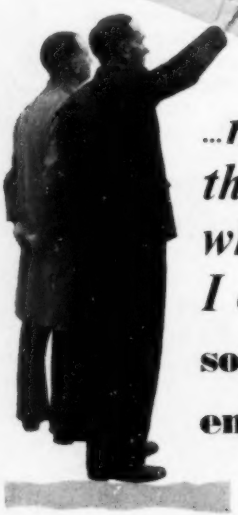

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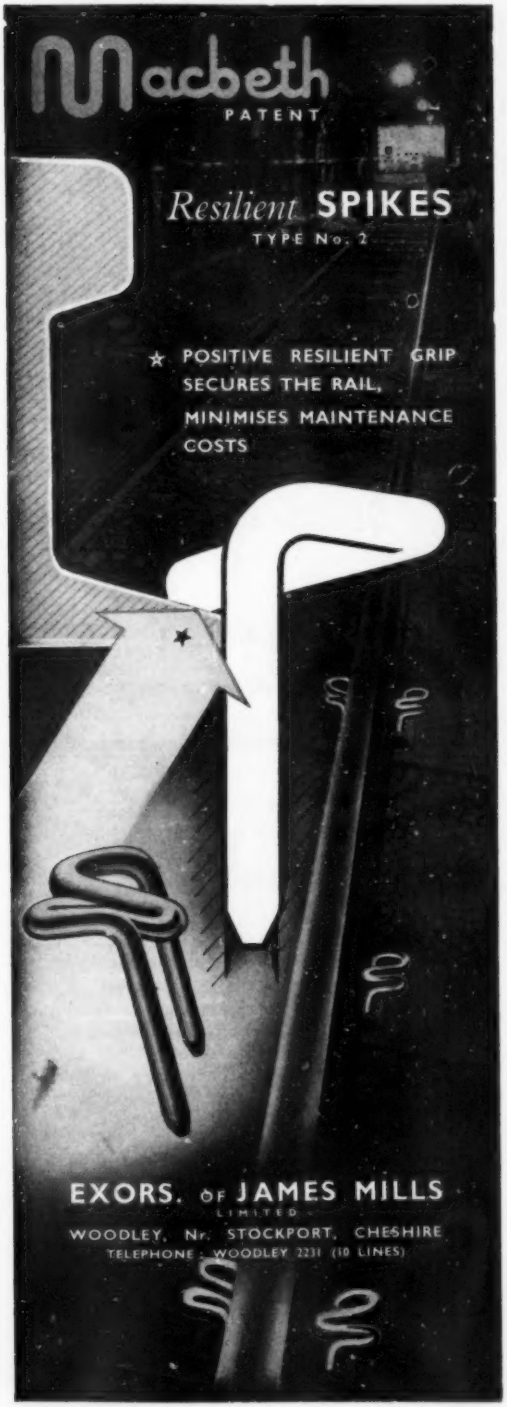

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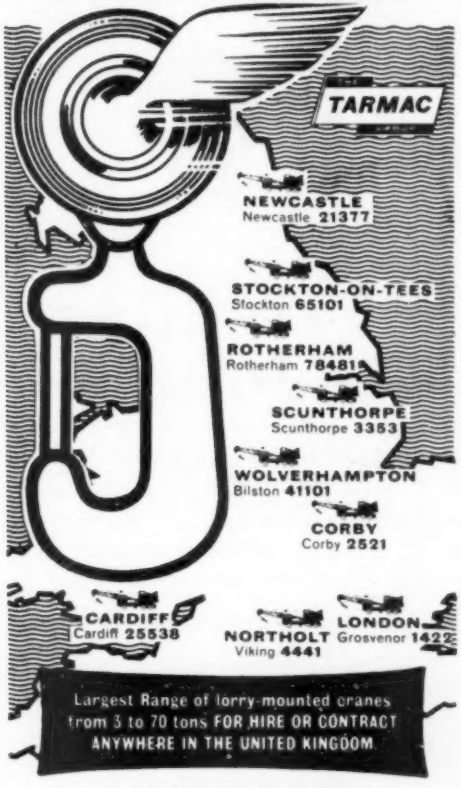

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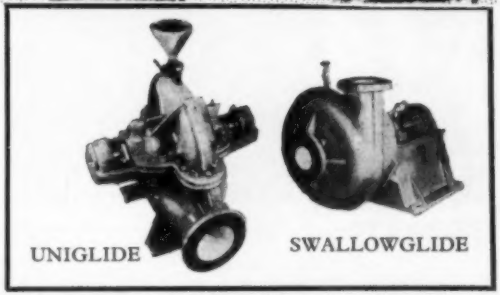

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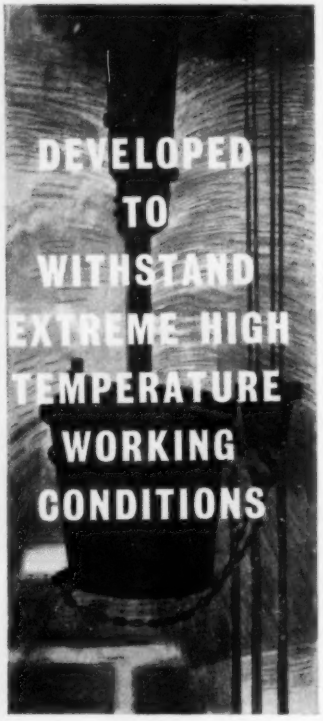

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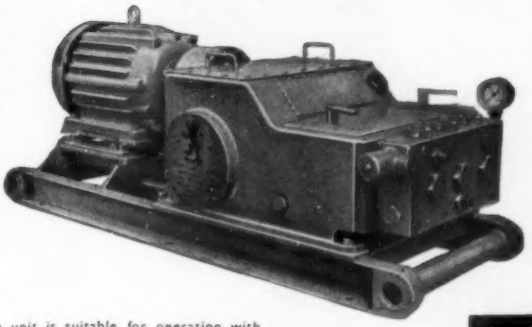

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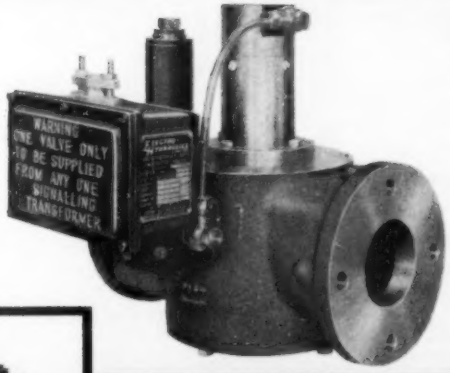

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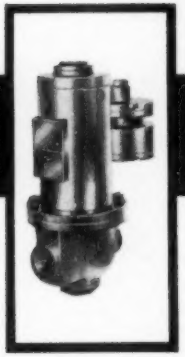

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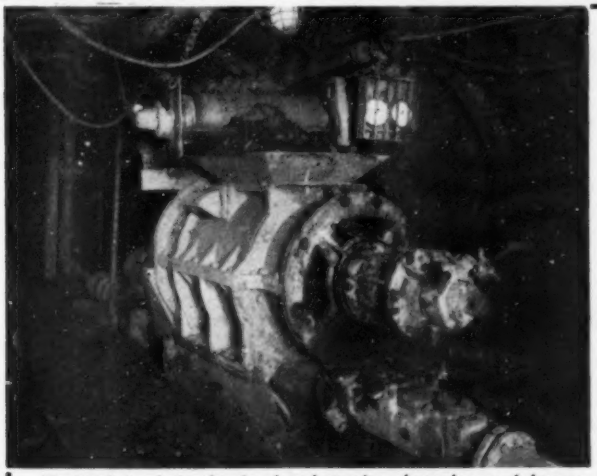

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